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THE CONDOR

VOLUME 57 JULY-AUGUST, 1955 NUMBER 4

A PRELIMINARY SURVEY OF THE SPARROWS OF THE GENUS AIMOPHILA

By ROBERT W. STORER

Even when one is aware that the taxonomy of birds is far from completed, it comes as a distinct surprise to discover in the field that a species is strikingly different in voice, behavior, and ecological preferences from several of the better-known species of the genus in which it has long been placed. I had such an experience in the summer of 1950 when I found the Rufous-tailed Sparrow, *Aimophila ruficauda acuminata*, common in the lowlands of southern Michoacán, México. From brief or casual field experience with the Pine-wood Sparrow (*Aimophila aestivalis*), the Cassin Sparrow (*A. cassinii*), the Botteri Sparrow (*A. botterii*), and the Rufous-crowned Sparrow (*A. ruficeps*), I had come to think of birds of the genus *Aimophila* as strictly territorial, the pairs being spread out during the breeding season and the males giving their "sparrowy" songs from low perches on trees, bushes, or weed stalks in their essentially grassland habitats; *A. cassinii* and *A. aestivalis* also perform song flights. From the literature, it also appears that the nests of these four species are placed on the ground and are tightly woven of fine grasses. Not so of *Aimophila ruficauda acuminata*. Even in the breeding season, birds of this species tend to be gregarious. The loud, rattling song is not infrequently sung in duets, the singers perching as close as two feet from each other in thorn scrub, which is their preferred habitat. Finally, the loosely constructed nest of twigs is placed in a thorn bush (fig. 1), and the bob-tailed juveniles, unlike those of the northern aimophilas, have only a few faint streaks on the breast.

Later in the same summer, I found the Black-chested Sparrow (*Aimophila humeralis*) in the tall, thorny vegetation on the west side of Cañon de Zopilote in Guerrero. In choice of habitat, flocking behavior, and voice, this species appeared to be strikingly similar to *A. r. acuminata*.

Subsequently, an examination of a series of skins of the Sumichrast Sparrow (*Aimophila sumichrasti*) in the Shufeldt Collection showed that the young of that species is only faintly streaked below and that the adult, in plumage characters at least, is similar in many respects to *A. r. acuminata* and quite different from the Rufous-winged Sparrow (*A. carpalis*), to which Ridgway (1901:231–233) stated it was closely related and with which Hellmayr (1938:522) indicated it might prove to be conspecific.

These considerations suggested the desirability of a survey of the species which have been included in the genus. Accordingly, material in the form of skins of both adults and juveniles and skeletons was borrowed from the United States National Museum, the Museum of Comparative Zoology, and the Museum of Vertebrate Zoology. Other specimens were examined at the American Museum of Natural History and the British Museum (Natural History); and the use of material from the private collections of R. W. Shufeldt (on deposit at the University of Michigan Museum of Zoology) and G. M. Sutton is also gratefully acknowledged. Thus, in the course of this survey, I examined skins of adults of all the species of *Aimophila*, juveniles of all except *quinquestriata*

and *strigiceps*, and skeletons of all except *quinquestriata, mystacalis, notosticta, botterii*, and *petenica*.

Within the limits of the genus *Aimophila*, Hellmayr (*op. cit.*) included the following species: *quinquestriata, mystacalis, humeralis, ruficauda, carpalis, sumichrasti, notosticta, rufescens, ruficeps, aestivalis, botterii, petenica, cassinii*, and *strigiceps*. Ridgway (*op. cit.*) listed the same forms within the genus except for the last, the range of which is geographically outside the scope of his work. Of these species, *aestivalis, botterii, petenica*, and *cassinii* form a natural group and have been placed in a separate genus, *Peucaea*, of which *aestivalis* is the type species. The species *ruficeps, carpalis*, and *notosticta*, have also been placed in *Peucaea*, but they are less closely related to *aestivalis* than are *botterii, petenica*, and *cassinii*.

Aimophila quinquestriata, the Five-striped Sparrow, differs from all other species now placed in *Aimophila* in being unpatterned above and in having a black spot in the center of the breast. Superficially it resembles the Black-throated Sparrow (*Amphispiza bilineata*) and it was placed in the same genus by Salvin and Godman (1886:368). However, *quinquestriata* differs from *bilineata* in having much stouter tarsi, a coarser texture to the plumage, and broader central rectrices which are tapered rather than nearly truncated terminally, all of which characters are shared by most aimophilas. I have not encountered this species in the field nor have I seen skins of juveniles or skeletons. Until more information on this species is forthcoming, I think it best to keep it in *Aimophila*.

Table 1

Variations in Proportions in Three Subspecies of *Aimophila ruficauda*

			Averages			Ratios		
Subspecies	No.	Sex	Wing	Tarsus	Tail	Wing/tarsus	Tail/wing	Tail/tarsus
ruficauda	3	♂	70.0	24.8	79+	2.83	1.15[1]	3.19+
ruficauda	1	♀	69.4	24.3	76+	2.86	1.10+	3.13+
lawrencii	6	♂	74.5	24.9	90	3.00	1.21[2]	3.61
lawrencii	5	♀	71.1	24.6	87.5+	2.98	1.24+[3]	3.55
acuminata	6	♂	64.1	24.8	77	2.59	1.20+[3]	3.09
acuminata	4	♀	63.0	24.4	75.5	2.58	1.19+[1]	3.05+

[1] Two specimens; [2] five specimens; [3] four specimens.

Aimophila ruficauda appears to be the most variable species of the genus, at least as regards size and proportions. Three of the subspecies, *ruficauda, lawrencii*, and *acuminata*, differ conspicuously in size, *lawrencii* being the largest and *acuminata* the smallest. Surprisingly, the three races have tarsi of nearly equal length (see table 1). Measurements of six skeletons of *ruficauda* and two of *acuminata* corroborate this, the skull, sternum, humerus, ulna, carpometacarpus, femur, and tibiotarsus of the former being significantly larger than the corresponding elements of the latter. However, the tarsometatarsi are nearly equal in length. Thus, tarsal length is of no value as an indicator of body size in this species.

A nest of *A. r. acuminata* was found near Coalcomán, Michoacán, by E. K. Miller in early August of 1950. It was three and one-half feet up in a thorn bush surrounded by other thorn bushes and acacias and 20 to 25 feet from a ditch choked with water hyacinths. As can be seen from the photograph of this nest (fig. 1), it was loosely constructed of twigs and lined with a few finer twigs and rootlets. The three eggs were bluish

white. The begging young, observed on August 12, displayed bright pinkish red mouth linings with brilliant yellow margins around the bill.

I know of only two other descriptions of the nest and eggs of *A. ruficauda*. Miller (1932:17) found a nest of the nominate race at Sonsonate, El Salvador, on July 19, 1925. It was in "a crotch five feet from the ground in dense bushes six feet high near the stream and also near a small grassy meadow" and was "composed chiefly of sticks and hair and was deeply cupped and neatly built." The clutch consisted of three pale blue, immaculate eggs. Except for the nest's being neatly built, Miller's description corresponds rather closely with the nest of *A. r. acuminata* found in Michoacán. Zimmerman and Harry (1951:313) mention two nests of *A. r. acuminata* found July 27, 1949, at Autlán, Jalisco. These were about five feet up in low acacias and were lined with horse hair.

Fig. 1. Nest and eggs of the Rufous-tailed Sparrow (*Aimophila ruficauda acuminata*). Photograph taken in early August, 1950, at Coalcomán, Michoacán, México, by E. K. Miller.

A nearly fledged nestling of *A. r. acuminata*, taken on August 8, 1950, represents a plumage which is apparently undescribed (fig. 2). This plumage in general resembles that of the adult but is duller in color and softer in texture. Below, there are some fine streaks across the region of the breast which may be more or less gray in the adult. The flank feathers are reddish buff, somewhat redder than those of the worn adult, and the head pattern, although dull, is well indicated. The feathers of the median crown stripe are dull grayish ochre with dusky centers, and the lateral crown stripes are plain brownish sooty. The black auricular and subocular regions of the adult are indicated by black

skin and a few dark feathers around the ear opening. The white superciliary stripe is also indicated by two small patches of white feathers, one above the eye and one posterior to the nostrils.

This species is a notably gregarious bird. As mentioned previously, even in the breeding season, they give their chattering song in duets and also choruses. H. O. Wagner said (oral communication) that he has seen five different adults feeding one young. In voice, habits, structure and placement of the nest, faintly streaked young, red lesser wing coverts, and lack of yellow at the wrist joint, this species differs strongly from *aestivalis* and its allies, *botterii, petenica,* and *cassinii.* Dickey and van Rossem (1938: 577) stated: "although so listed here, we do not believe for a moment that this sparrow is an *Aimophila.*"

Aimophila humeralis is closely related to *ruficauda.* Although the two species are rather differently marked, the broad black breast band and reduced streaking on the back of *humeralis* are suggested in the southern forms of *ruficauda.* Like *A. r. acuminata, humeralis* is a bird of arid tropical scrub, and it is common in this type of vegeta-

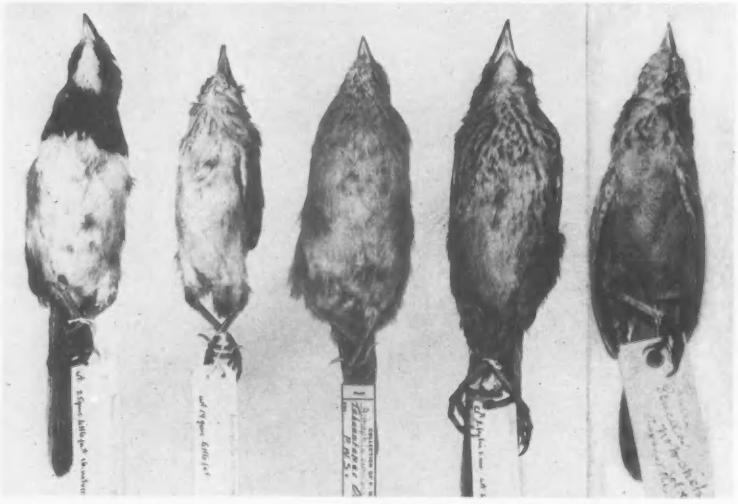

Fig. 2. Aimophilas in juvenal plumage. Left to right: *A. humeralis* (UMMZ 130,905), *A. ruficauda acuminata* (UMMZ 130,913), *A. sumichrasti* (Shufeldt Coll.), *A. rufescens subvespera* (UMMZ 130,922), and *A. notosticta* (Brit. Mus.). Photographs by W. L. Brudon and the author.

tion in Cañon de Zopilote, Guerrero. I have not seen a bob-tailed juvenile of this species, but a young bird in postjuvenal molt was taken in Cañon de Zopilote on August 29, 1950 (fig. 2). The central part of the breast band of this specimen consists of black feathers of the adult plumage, but the feathers of the lateral portions of the band and the top of the head are unmarked Drab (Ridgway, 1912) and belong to the juvenal plumage. Some buffy juvenal feathers are present on the flanks, and the remaining juvenal feathers on the back and rump are unmarked. Apparently the juvenal plumage of this species has few or no streaks.

In call notes and gregariousness, as well as in habitat preference, *humeralis* resembles *ruficauda*, but apparently little or nothing is known about its breeding habits. H. O. Wagner (*in litt.*) told me that he found both *humeralis* and *ruficauda* molting at Lake Tequesquitengo, Morelos, between May and July, prior to the breeding season, which in both species in this region occurs in July and August.

In the configuration of the skull and in skeletal proportions, *humeralis* is very much like *ruficauda*, the only significant difference being that the leg elements, especially the tibiotarsus and tarsometatarsus, are shorter in *humeralis*.

Aimophila mystacalis, the Bridled Sparrow, has a rather limited distribution along the southeastern edge of the Mexican Plateau in the states of Veracruz, Puebla, and Oaxaca. It resembles *humeralis*, *ruficauda*, and *sumichrasti* in having bright flanks, rump, and undertail coverts, rufous lesser wing coverts, a light mandible and dark maxilla, and a dark breast band. Like *sumichrasti* and *ruficauda*, the back is heavily streaked. *A. mystacalis* differs from all three of these related species in having a black throat and tail and a gray crown streaked with sooty but without definite crown stripes.

Two specimens in juvenal plumage have light throats with broad sooty margins. They differ markedly from the young of *ruficauda*, *sumichrasti*, and *humeralis* in having the breast heavily but diffusely streaked.

I have seen no skeleton of this species and have been unable to discover anything concerning its habits or habitat preference. However, in spite of the streaking of the juvenal plumage, it is most probably a close relative of *humeralis*, *ruficauda*, and *sumichrasti*.

A. mystacalis, *A. humeralis*, and *A. ruficauda acuminata* have all been taken at Chietla, Puebla (Hellmayr, 1938:517, 518, 521). A comparative study of these three species at such a place would add much to our knowledge of this section of the genus.

Aimophila sumichrasti is a little-known species apparently confined to the arid tropical zone of Oaxaca. In the Shufeldt Collection there are six adults and one fully-grown juvenile, all taken at Tehuantepec in the months from August through October. Most of the adults show evidence of wing and/or tail molt. Apparently it is not known whether or not this species has a spring molt, and nothing has been recorded about its habits.

The juvenal plumage of this species has not been described. The juvenile in the Shufeldt Collection (fig. 2) is beginning the postjuvenal molt in the scapular tract and on the throat and upper breast. The pattern of the streaks of the crown and back of the adult is present in the juvenile, but the streaks are much fainter and less well defined. The pattern of the side of the head, involving the superciliary, transocular, subocular, and moustache stripes, is present, but the dark stripes are lighter and browner and the light ones are darker than those of the adult. There are a few faint streaks on the upper breast; otherwise the under parts are unmarked. The juvenal flank feathers are warm buff, similar to but lighter than those of the adult. On the original label the color of the iris is recorded as "brown," the maxilla as "sepia," and the mandible, legs, and feet as "flesh." For the adults in Shufeldt's series, the colors of the soft parts are given variously as follows: iris, "brown," "burnt sienna," or "Vandyke brown"; maxilla, "sepia" or "light sepia"; mandible, "flesh"; and legs and feet, "flesh" or "light flesh."

I believe that *sumichrasti* is most closely related to *ruficauda*, which it resembles in proportions, except for its relatively shorter tail, as well as in many features of its plumage. Both species have warm buff flanks and under tail coverts, a broad gray breast band (pale in *sumichrasti* and varying from dark to obsolescent in *ruficauda*). In *sumichrasti* the phaeomelanins are more, and the eumelanins less, conspicuous, especially in the bill, head, wings, and tail; in *ruficauda*, the reverse is true, although *A. r. lawrencii*, which

is sympatric with *sumichrasti*, shows a tendency toward a reduction in eumelanins and an increase in phaeomelanins over the other subspecies. The juvenal plumage of *sumichrasti*, like that of *ruficauda*, resembles that of the adult in pattern and has few streaks on the under parts. In contrast, juveniles of *carpalis* are strongly streaked below like those of the "peucaeas" and spizellas. The general similarity of the pattern of *sumichrasti* and *carpalis* is, I think, fortuitous. Indeed, the retention by two species of what may be a relatively primitive color pattern for the group is not necessarily an indication of close relationship. *A. sumichrasti* may be a "primitive" member of its group, as it lacks the bold patterns on the head and breast which characterize *ruficauda*, *humeralis*, and *mystacalis*. Its relative scarcity with respect to *ruficauda* where the two occur, as indicated by specimens collected, corroborates this, as does the fact that it has a much restricted range.

Since writing the foregoing, I have been able to examine skeletal material of *A. sumichrasti* through the courtesy of Dr. Pierce Brodkorb. The skulls of *A. sumichrasti*, *A. humeralis*, and *A. r. acuminata* are very similar. This similarity is particularly evident in the auditory bulla and the side of the cranium. *A. sumichrasti* differs from the other two species in having a somewhat narrower bill and interorbital space and a slightly less extensive area of muscle attachment on the side of the cranium. The limb proportions of *A. sumichrasti* are quite similar to those of *A. humeralis*. The evidence from the skeleton strengthens my belief that *A. sumichrasti* is closely related to *A. ruficauda* and *A. humeralis*.

Aimophila strigiceps is the only South American species of the genus. Its range is entirely within the northern half of Argentina and thus is separated from that of its nearest congeners by more than two thousand miles.

A. strigiceps resembles birds of the *sumichrasti-ruficauda-humeralis* group rather closely. In pattern it is closest to *sumichrasti*, having similar crown and transocular stripes and a dark moustache streak. *A. strigiceps* also has a faint gray breast band, light buffy flanks, and a light base to the mandible. In skeletal proportions it resembles *ruficauda* and *humeralis*; the auditory bullae of *strigiceps*, however, are somewhat smaller than those of the other two species. Wetmore (1926:424) compared *strigiceps* with *rufescens* and remarked that it differed "from that bird [*rufescens*] structurally mainly in its smaller more delicate feet." This difference is borne out by skeletal material, as is a resemblance between the feet of *strigiceps* and those of *ruficauda* and *humeralis*.

As to habitat, Wetmore (*op. cit.*:13) described the country around Tapia, where he collected this species, as "covered with a low scrub forest in which occasional clearings had been made." In discussing this species, he later (p. 425) remarked that it is "found associated with chingolos (*Brachyspiza*) in growths of more or less open brush and weeds . . . . Those taken uttered a sharp, chipping note." Thus in habitat, and probably also in voice, *A. strigiceps* shows a resemblance to the *sumichrasti-ruficauda-humeralis* group, which may be thought of as having a center of differentiation in southern México. The peripheral distribution, small auditory bullae, and the relatively unspecialized color pattern of *A. strigiceps*, as compared with that of *A. humeralis*, suggest that it is a relict of an early dispersal of the group.

Chapman, following Wetmore's comparison of *stripiceps* with *rufescens*, stated (1940:385): "If, as seems probable, it [*strigiceps*] has been properly placed in the northern genus *Aimophila*, the nearest species of which inhabits the highlands of Costa Rica, its distributional history may, in part, resemble that of *Zonotrichia capensis*." In spite of the fact that *strigiceps* occurs with *Zonotrichia* [*Brachyspiza*] *capensis* at Tapia, I do not think that the distributional histories of these two groups could have

been similar. Birds of the group to which *strigiceps* belongs are inhabitants of arid tropical scrub; the zonotrichias are essentially boreal species. In fact, if Wetmore had compared *strigiceps* with *ruficauda,* which ranges south into the lowlands of Costa Rica, Chapman might never have been led to suggest a similarity in the distributional histories of the two groups.

In this connection, it is of interest to note the close resemblance between *sumichrasti* and *Rhynchospiza stolzmanni* of Ecuador and Perú, a similarity which led Chapman (1926:625) to consider the possibility that this monotypic genus had a Middle American origin. *Rhynchospiza stolzmanni* differs from *sumichrasti* and its close relatives

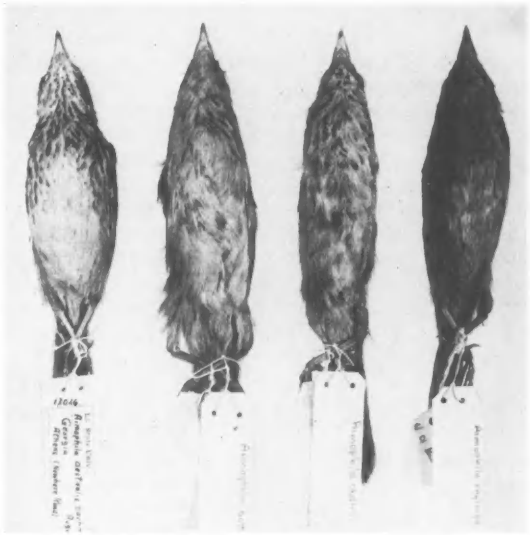

Fig. 3. Aimophilas of the "peucaea" group in juvenal plumage. Left to right: *A. aestivalis bachmani, A. botterii, A. cassinii,* and *A. ruficeps scotti,* all specimens from Peet Collection in the UMMZ. Photograph by W. L. Brudon.

by having a much larger bill and a patch of yellow under the bend of the wing, a character shared by the "peucaea" group of aimophilas. If Chapman was correct in postulating an origin of *Rhynchospiza* from the *sumichrasti* group, it seems probable that the aimophilas had a much earlier dispersal into South America than did *Zonotrichia capensis.*

Aimophila carpalis is a species which does not appear to have any close relatives. Hellmayr (1938:522) suggested that *sumichrasti* may prove conspecific with it. However, for reasons mentioned earlier, I believe that *sumichrasti* is related to *ruficauda* and *humeralis* rather than to *carpalis.*

Recently, Pitelka has suggested (1951:47–48) that *carpalis* may be a *Spizella,* largely on the basis of its habits. However, there are certain structural characters which I think prevent its being placed in that genus. Foremost of these is the configuration of

the cranium. In *carpalis* the auditory bullae are quite small, and there is a relatively broad U-shaped area for the attachment of the jaw muscles immediately dorsal and anterior to the bulla. In *Spizella*, the bullae are much larger, and the area for muscle attachment is narrower and V-shaped. *A. carpalis* also differs from *Spizella* in having the posterior end of the palatines broad rather than pointed, and in having broad and blunt central tail feathers like those of *Aimophila ruficeps*.

In the size and form of the auditory bullae, *carpalis* resembles *ruficauda*, *humeralis*, and *rufescens* most closely, and in the configuration of the side of the cranium it is again closest to *humeralis* and *ruficauda* although somewhat different from both. The broad expansions of the posterior end of the palatines are perhaps most like those of *ruficeps* but in some respects are unique. The juvenal plumage of *carpalis* is said by Pitelka (*in litt.*) to be "*Spizella*-like" and thus somewhat like the comparable plumage of *ruficeps* and the *aestivalis* group. Hence, *carpalis* appears to occupy a taxonomic position somewhere between *ruficeps* and *rufescens* on the one hand and members of the *ruficauda* group on the other. Although in superficial pattern it resembles *sumichrasti* rather closely, it is certainly not closely related as Hellmayr indicated. The juvenal plumages, the proportions, and several plumage characters of the adults are strikingly different.

Aimophila rufescens, the type species of the genus, ranges from northern México to northwestern Costa Rica and is common in the temperate zone. As might be expected from the discontinuous distribution of its habitat, it is divided into several races, eight being recognized by Hellmayr (1938). In many respects the plumage resembles that of *sumichrasti*. It lacks, however, the rufous at the bend of the wing and the black subloral streak of the latter; the whole tone of the plumage is more olive-brown and less rufous, especially on the rump, tail, and flanks; and the median crown stripe and the streaks on the back are less well defined. In fact, the latter are almost or even quite obsolete in some individuals and some races. *A. rufescens* is also a larger bird with relatively heavier bill and feet and broader rectrices.

The juvenal plumage of *rufescens* appears to be unique in the genus in having a strong yellow wash on the sides of the head and on the under parts, a character which it shares with *Oriturus superciliosus* and several other neotropical buntings. In this plumage the under parts are streaked like those of *ruficeps*, *carpalis*, and the "peucaeas."

The skull of *rufescens* differs from those of *ruficauda* and *humeralis* in the relatively greater development of the auditory bullae. In this character it approaches *ruficeps* and the "peucaeas," although it differs from these forms in several other details of this region of the skull. Large auditory bullae appear to be correlated with terrestrial habits, although the connection is by no means understood. This character reaches a much greater degree of development in *Oriturus* than in any of the aimophilas which I have examined.

A. rufescens does not appear to be as close to *sumichrasti* and its relatives as the resemblance of the adult plumage suggests, nor is it particularly close to the "peucaeas." In some respects it resembles the smaller species *ruficeps*, with which it shares much of its range. A comparative study of these species should prove extremely interesting. The closest relative of *rufescens* may prove to be *notosticta*, but the juvenal plumage of that species lacks the characteristic yellow of the young of *rufescens*.

Aimophila notosticta has a limited range in the mountains of Oaxaca. Goldman (1951:379) listed it as an inhabitant of the Lower Austral Zone. The adult of this species resembles that of *rufescens* most closely, but it is smaller and relatively longer tailed and smaller billed. The dark streaks on the back are more pronounced and the

general tone of coloration is less rufous than that of *rufescens*. According to Ridgway (1901:242), the mandible of *notosticta* is black like the maxilla, and this is certainly true of the old skins which I have examined. As mentioned earlier, the juvenal plumage lacks the yellow found in the juveniles of *rufescens*. The streaking on the breast is bolder, There being fewer but heavier streaks (fig. 2). As far as I can determine, the habits, habitat preference, and skeleton of this species are unknown. Until more is known about it, I prefer to place it next to *rufescens*.

CONCLUSION

The genus *Aimophila* as now constituted is not a natural assemblage. Two groups of species stand out as discrete. The first contains the species *mystacalis, humeralis, ruficauda, sumichrasti,* and *strigiceps,* which inhabit arid tropical scrub; and the second includes the species *aestivalis, botterii, petenica,* and *cassinii,* which are found in temperate grassland or savanna. The remaining species, *quinquestriata, carpalis, ruficeps, notosticta,* and *rufescens,* cannot, on the basis of our present knowledge, be readily placed in either of the two groups. Eventually it will probably be advisable to split *Aimophila* into two genera, but if this were done now and the four species of uncertain affinities were divided between the two genera, we would have two unnatural groups instead of one. This is hardly justifiable. What is most needed is a series of studies on the life history and anatomy of the little-known members of the group. Until these have been made, I think that the *status quo,* unsatisfactory as it is, should be maintained.

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University of Michigan Museum of Zoology, Ann Arbor, Michigan, March 25, 1955.

THE GLAUCOUS GULL IN WESTERN NORTH AMERICA SOUTH OF ITS BREEDING RANGE

By DAVID W. JOHNSTON

For many years ornithologists have considered the Glaucous Gull (*Larus hyperboreus*) to be a rare winter visitor along the coast of western North America south of its arctic and subarctic breeding grounds. With the possible exception of certain pelagic species of gulls, the Glaucous Gull is probably the least common of the eight-odd species which visit this coastline. Nevertheless, because of its large size and conspicuous plumage, this species has received considerable attention from ornithologists, and a survey of the literature and museum collections will reveal numerous sight records and specimens. Primarily on the basis of the sight records, it has generally been agreed that most of the observations have been of immature birds, and, since the age groups of this species are difficult if not impossible to distinguish infallibly under field conditions, birds observed in the field have usually been called just immature or adult. By carefully examining extant specimens and relegating them to the proper age groups, it is now possible to give a more accurate picture of the extent to which these various age groups occur south of the breeding grounds.

The present study deals primarily with 77 specimens which have been examined from the Museum of Vertebrate Zoology, California Academy of Sciences, United States National Museum, and the Los Angeles County Museum. More than one-half of these specimens were collected at or near the breeding grounds in Alaska, but it was necessary to examine as many specimens as possible so that the characteristics for all the age groups might be correctly ascertained. Following this detailed study of plumages, descriptions of the age groups were sent to collaborators at other museums in order to make this survey of specimens as complete as possible. Only those specimens from the four museums mentioned above have been examined personally. The following is a list of the museums and collaborators who have had specimens to contribute to this study: Museum of Vertebrate Zoology (Alden H. Miller), California Academy of Sciences (Robert T. Orr), Los Angeles County Museum (Kenneth Stager), San Diego Natural History Museum (Laurence H. Huey), Dickey Collection (Thomas R. Howell), University of Oregon Museum of Natural History (J. Arnold Shotwell), United States National Museum and Patuxent Research Refuge collection (Allen J. Duvall), American Museum of Natural History (Dean Amadon), Chicago Natural History Museum (Emmet R. Blake), Provincial Museum (C. J. Guiguet), Royal Ontario Museum (L. L. Snyder), University of British Columbia (I. McT. Cowan), Hamilton M. Laing, and Ronald M. Stewart. I am also indebted to Howard L. Cogswell who has given valuable assistance in the determination of age group characteristics. Since several important specimen records have been furnished by private collectors, it is possible that there are additional records not revealed by this survey.

The original intention of this study was to determine the distribution of the Glaucous Gull, but in the course of examination of specimens, certain important characteristics of the different age groups which other authors have not emphasized have been brought to light. In addition, significant and diagnostic differences have been brought out between the Glaucous Gull and the Glaucous-winged Gull (*L. glaucescens*), especially in the subadults.

DESCRIPTIONS OF AGE GROUPS

The usual designation for the puzzling age groups of gulls is simply immature and adult, this being the case in most field guides. Dwight (1925) and others, however, have

realized that "immature" might embrace as many as three different, separable plumages, these being sequential annually. First by using molting birds and later by confirmation with banded birds (in some species), it has been possible to express qualitatively for each species the plumage and soft-part characteristics for the age groups. Dwight's detailed paper has stood for many years as the authority in such matters, but due to the large scope of this study (gulls of the world), he usually was unable to examine more than a few individuals of each age group or species. The present intensive report on molts, plumages and soft-part colors for the Glaucous Gull is intended to supplement Dwight's descriptions by emphasizing certain of the characteristics which he recognized and by indicating others not generally utilized for this species.

First-year Birds.—This age group is probably the most puzzling because of plumage variations and fading. The characteristics of this age group are not as clear-cut as Dwight's figures would lead one to believe. Nevertheless, there are certain general features found in birds of this age: the back, head, mantle and underparts are generally mottled with pale buff or pale brown. The overall appearance usually is of a whiter bird when compared with *glaucescens* of the same age, and of a more speckled or mottled bird when compared with the typical second-year ***hyperboreus***. According to Dwight, the primaries are usually pale drab or dark gray with colored shafts and mottled or freckled tips. My own examination of such birds has shown that the primaries may be either pure white or pale drab, and they are frequently mottled. Secondaries are usually of the drab or gray-brown, mottled type; they are less frequently white; the coverts are similar. The tail is marbled with irregular white and brownish-gray areas, although in one bird it was practically white with only a few such markings. In an unworn tail, there is a conspicuous subterminal whitish or buffy band. One of the most noticeable and useful identifying features of this age group is the bill coloration, which, even in old museum skins, has been found to be consistent: the basal one-half (approximately) is pinkish white, whereas the terminal one-half is black.

In the late winter and spring this plumage fades and wears considerably so that birds during this time appear whiter than earlier in the year. Similar effects are to be found in first-year *glaucescens*, with the result being a rather whitish bird that superficially resembles ***hyperboreus***. Field observers and collectors have been confused by such "white" gulls, and usually such birds are called ***hyperboreus*** just because they are large and whitish. By examination of such worn and faded specimens, however, several misidentified birds have been found. Even in the most worn plumages where only the shafts of the rectrices and remiges are left, it is possible to recognize *glaucescens* because of the following features. The primaries and secondaries of *glaucescens* are generally darker, especially on the inner vanes. Similarly, the tail is darker and has fewer mottlings especially on the outer vane of the outermost rectrix which is conspicuously mottled in ***hyperboreus***. Thus, the tail is more nearly uniformly grayish brown. Finally, the bill of first-year *glaucescens* is uniformly black. The following Californian specimens, some of which are recorded in the literature, have been previously considered to be ***hyperboreus***, but in the light of these characteristics should be called *glaucescens*.

U. S. N. M.	♂	E. J. Brown	Mar. 14, 1915	Hyperion, Los Angeles Co.
J. E. Law Coll.	♀	L. E. Wyman	Jan. 30, 1915	Hyperion, Los Angeles Co.
Univ. Calif. Zool. Dept.	♀	C. P. Streator	May 27, 1940	Santa Cruz, Santa Cruz Co.
M. V. Z.	♀	C. P. Streator	June 14, 1938	Santa Cruz, Santa Cruz Co.
Ellis Coll.	sex?	coll.?	Mar. 17, 1927	Bodega Bay, Sonoma Co. (second-year bird)
Ellis Coll.	sex?	coll.?	Mar. 14, 1926	Monterey Bay, Monterey Co.

This study of specimens should caution field observers in the identification of large white gulls in late winter, spring and summer, because a white-appearing gull is not necessarily *hyperboreus* but may be a worn, faded *glaucescens*.

According to Dwight, a complete annual molt occurs in August and September, but birds from Alaska were also found to be molting in July.

Second-year Birds.—In this plumage there is much variation in the amount of mottling on the back, wings and underparts. Depending somewhat upon wear and fading, birds may be either completely white or mottled much like the first-year birds. The primaries are usually whiter than those of first-year birds, but they may be pale pinkish brown. The back and mantle area may be entirely white or obscurely mottled with pale brown. No gray was found in the mantle of any of the birds examined. Also, the underparts may be white or mottled, but if mottled, they are lighter than in first-year birds. The tail is white or finely and variably mottled. There is usually a less distinct blackish tip to the bill than in first-year birds, although two birds (one fresh from the field) had completely black bills and five others closely resembled first-year birds in this character.

According to Dwight there is a partial prenuptial molt in April and May at which time gray feathers begin to appear in the mantle. Although this may be true for some individuals, specimens taken in April and May and examined in the present study were not molting and had no gray in the mantle. Two birds from Alaska in July were undergoing annual molt and new gray mantle feathers were just beginning to appear among the old mottled feathers of the mantle. These latter birds further show that the annual molt for this age group occurs in July as well as in August and September.

Third-year Birds.—In the third-year plumage birds rather closely resemble adults, and usually they differ strikingly from second-year birds. The primaries are usually white but they may have a pale pinkish brown tinge. Otherwise, the wings vary from gray to sparsely mottled. The mantle is usually pale gray as in adults, but in a few birds it was found to be sparsely mottled with pale brown. Also, the underparts are usually white but there may be variable amounts of pale brownish "clouding." The tail is usually white but sometimes there is some pale brownish mottling. Although no fresh birds have been examined to determine the true colors of the soft parts, the bill is apparently yellowish basally with about one-third of the tip blackish. In none of the five specimens examined was there any suggestion of a red spot on the lower mandible, although birds recently molted into the adult plumage in late summer begin to attain this reddish spot.

Whereas Dwight determined that the complete molt to the adult plumage occurs in August and September, two birds from Alaska taken on July 18, 1931, were in advanced stages of molt. Six or seven new white primaries are present and the head and neck areas are molting extensively. On the other hand, the rectrices are all old.

Adult Birds.—The detailed description of the adult plumage as given by Dwight has been found to be correct. Only two specimens out of thirty-three showed faint brownish mottling on the head and neck; all the others had pure white heads, necks and underparts and pale gray mantles. The bill in all these specimens was yellowish with a red spot at the angle.

Five adults taken at St. Michael, Alaska, on June 7, 1931, had three well developed incubation patches and enlarged gonads. Four of the birds were molting primaries. Similarly, specimens taken in July and August were molting primaries, rectrices and body feathers. One specimen, taken on October 8, 1927, at Nunivak Island, Alaska, had the outer two primaries still partly ensheathed, thus indicating that the annual molt may span the period from June to October in this age group.

Table 1

Specimens of the Glaucous Gull from Western North America

British Columbia

Museum	Collector	Sex	Age	Date	Locality
	R. M. Stewart	♂	2nd yr.	Dec. 7, 1942	Masset, Queen Charlotte Isl.
	R. M. Stewart	♂	1st yr.	Jan. 9, 1945	Masset, Queen Charlotte Isl.
Univ. B. C.	————	♀	1st yr.	May 15, 1947	Langara Island, Q. C. I.
Univ. B. C.	————	♀	1st yr.	May 14, 1947	Langara Island, Q. C. I.
Univ. B. C.	————	♀	1st yr.	May 18, 1931	Tofino, Vancouver Island
M. V. Z.	A. Brooks	♀	1st yr.	Dec. 17, 1925	Comox, Vancouver Island
	H. M. Laing	♂	1st yr.	Dec. 18, 1935	Comox
A. M. N. H.	A. Brooks	♂	"im."	Sept. 15, 1903	Comox
M. V. Z.	A. Brooks	♀	2nd yr.	Mar. 15, 1926	Nanaimo, Vancouver Island
Roy. Ont. Mus.	J. A. Munro	♀	2nd yr.	Mar. 7, 1929	Departure Bay
Roy. Ont. Mus.	J. A. Munro	♀	2nd yr.	Mar. 23, 1938	Departure Bay
Prov. Mus.	R. A. Cummings	♀	1st yr.	Mar. 11, 1931	Vancouver
Chic. N. H. Mus.	R. A. Cummings	♂	1st yr.	Feb. 11, 1929	Vancouver
Prov. Mus.	W. McKay	♂	adult	Feb. 11, 1921	Kildonan, Vancouver Island
M. V. Z.	A. Brooks	♀	2nd yr.	May 4, 1944	Okanagan
M. V. Z.	A. Brooks	♀	2nd yr.	Apr. 8, 1924	Okanagan
M. V. Z.	A. Brooks	♀	1st yr.	Apr. 7, 1938	Okanagan

Washington

U. S. N. M.	H. H. Hindshaw	♂	2nd yr.	May 12, 1896	Seattle Harbor
Dickey Coll.	D. E. Brown	♀	2nd yr.	Jan. 14, 1918	Tacoma, Pierce Co.
U. S. N. M.	S. G. Jewett	♀	2nd yr.	May 28, 1942	Copalis, Grays Harbor Co.
Dickey Coll.	D. E. Brown	?	2nd yr.	May 5, 1920	Westport, Grays Harbor Co.

Oregon

San Diego Nat. Hist. Mus.	E. Clark	♀	1st yr.	Dec. 12, 1914	Sauvies Island
Patuxent Coll.	————	♂	2nd yr.	Jan. 28, 1933	Bay Ocean, Tillamook Co.
Univ. Ore. Mus. Nat. Hist.	A. C. Shelton	♂	1st yr.	Apr. 4, 1914	Netarts
Univ. Ore. Mus. Nat. Hist.	A. C. Shelton	♂	2nd yr.	Apr. 28, 1915	Mercer Lake

California

M. V. Z.	A. Brooks	♂	adult	Mar. 4, 1936	Suisun, Solano Co.
M. V. Z.	D. W. Johnston	♂	1st yr.	Jan. 29, 1953	Richmond, Contra Costa Co.
M. V. Z.	D. W. Johnston	♀	2nd yr.	Nov. 26, 1952	Richmond, Contra Costa Co.
Calif. Acad. Sci.	R. H. Beck	♂	2nd yr.	Mar. 30, 1910	Alameda, Alameda Co.
Calif. Acad. Sci.	R. H. Beck	♀	1st yr.	Mar. 6, 1907	Monterey Bay
M. V. Z.	R. H. Beck	♀	1st yr.	Feb. 13, 1939	Monterey Bay

Table 1 *(Continued)*

Museum	Collector	Sex	Age	Date	Locality
M. V. Z.	R. H. Beck	♂	2nd yr.	Feb. 20, 1939	Monterey Bay
M. V. Z.	R. H. Beck	♂	1st yr.	Dec. 30, 1910	Monterey Bay
M. V. Z.	J. C. von Bloeker, Jr.	♂	2nd yr. (?)	Jan. 5, 1937	Seaside, Monterey Co.
Chic. N. H. Mus.	L. B. Bishop	♂	1st yr.	Mar. 31, 1922	Hyperion, Los Angeles Co.
J. E. Law Coll.	L. E. Wyman	♂	2nd yr.	Feb. 18, 1915	Hyperion
L. A. Co. Mus.	L. E. Wyman	♀	1st yr.	Jan. 28, 1921	Hyperion
L. A. Co. Mus.	G. Willett	♀	1st yr.	Feb. 18, 1918	Hyperion
L. A. Co. Mus.	L. E. Wyman	♀	1st yr.	Nov. 24, 1915	Hyperion
Chic. N. H. Mus.	L. B. Bishop	♂	1st yr.	May 13, 1922	Sunset Beach
San Diego Nat. Hist. Mus.	Frank Stephens	♀	2nd yr.	May 6, 1919	San Diego, San Diego Co.

RESULTS AND DISCUSSION

Table 1 includes all the known specimens of the Glaucous Gull which were examined or "discovered" by this study. At first appearance, it would seem that this species is more common in British Columbia and California than in Washington and Oregon, but this is not necessarily true because the coastline of these states and province are of different lengths and there are, or have been, relatively more collectors in the first-named areas. Even so, this tabulation of specimens does reveal several notable facts concerning the distribution of this species and its age groups on the west coast of North America.

Local observers will probably be impressed with the significant number of heretofore unpublished but old records. For California, Grinnell and Miller (1944:168) recorded eight specimens whereas table 1 reveals sixteen specimens, not including those three which have been removed from this state list (see discussion of first-year birds).

If one can assume that birds of different ages were collected in a random fashion, then it becomes immediately apparent that the subadult birds are much more common than adults south of the breeding grounds. In fact, out of 41 specimens, there are only two adults. Furthermore, there seems to be a tendency for the younger subadults to occur farther south: table 1 shows 20 first-year birds, 18 second-year birds and no third-year birds. Whether or not this is an indication of the over-all abundance of the age groups for this species cannot be stated with finality, but from personal observations and collecting of California Gulls (*L. californicus*) on the wintering grounds, I have been led to believe that first-year birds are more abundant than second-year and second-year more abundant than third-year birds in this species.

In several other species of gulls, various investigators have demonstrated from banding records that the younger age groups tend to migrate or wander farther than the adults. This is true for the Glaucous-winged Gull (Woodbury and Knight, 1951:68) and for the Herring Gull (*L. argentatus*; Gross, 1940:153), and there are indications that the same phenomenon occurs in the California Gull and Western Gull (*L. o. occidentalis;* Woodbury and Knight, *op. cit.*, :70).

It is instructive to note that the sex ratio is nearly 50:50. There are 19 males and 21 females, and even a breakdown of the sexes in each age group is still nearly 50:50. This sample of 40 birds of known sex is admittedly small, but it does indicate that there is apparently no significant differential migration between sexes, even though there is a noticeable differential migration among the various age groups.

Table 1 and the examination of specimens from the breeding grounds indicate that

most if not all of the subadults return to the vicinity of the breeding grounds during the breeding season, although little is known about breeding of subadults in this species. There are indications, however, that only the adult birds actually breed even though subadults may be present in the vicinity. Whereas adults collected at various localities in Alaska had enlarged gonads and/or incubation patches during the breeding season, none of the subadults at this time from these localities had either enlarged gonads or incubation patches. In the California Gull (unpublished data) relatively few subadults return to the breeding colonies and virtually none of them breeds. More data are needed on this subject for the Glaucous Gull.

Relatively few of the specimens were collected in the fall or early winter months. This might mean that this hardy species is not driven southward until the most severe winter weather in midwinter. And the numerous records in the spring (April and May) might simply be a reflection of the more conspicuous nature of a large, white gull at a time when most of the other wintering gull species (at least the adults) have already left for their breeding grounds. Certainly in midwinter when *glaucescens* is abundant on the coast of California, it would be easier to overlook *hyperboreus* than at a later time when *glaucescens* is virtually absent.

SUMMARY

Detailed descriptions of the four age groups of the Glaucous Gull are presented, showing the differences in plumage and soft-part colors. During the late winter and spring months, much fading and wear of plumage occurs in first-year Glaucous and Glaucous-winged Gulls so that the two appear superficially alike, but characteristics are given whereby first-year specimens of the two species may be separated. By utilizing these characteristics, several specimens previously recorded as *hyperboreus* have been identified as *glaucescens*.

By examining specimens and by canvassing museums and collectors, 41 specimens of *hyperboreus* are reported from the west coast of North American south of the breeding grounds. Of these, there are 20 first-year birds, 18 second-year, no third-year and two adult birds (plus one of unknown age), indicating that the subadults are much more common than the adults in these southerly latitudes.

A nearly equal sex ratio indicates that there is no differential migration between the sexes.

Data are presented to suggest that, even though subadults return to the vicinity of the breeding grounds during the breeding season, probably none of them breeds.

Most of the subadult specimens collected on the west coast of North America have been taken during the winter and spring months.

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OBSERVATIONS ON THE BREEDING BIOLOGY OF KINGBIRDS

By DAVID E. DAVIS

The principal purpose of this paper is to suggest methods for handling miscellaneous observations on birds' nests, using those of Eastern Kingbirds (*Tyrannus tyrannus*) as examples. A variety of problems in the breeding biology of birds require data from many nests for their solution. These problems include variation in clutch-size within one season, from place to place, and from year to year, as well as time of maximum nesting and per cent hatch. The accumulation of adequate data to clarify these problems is slow because a large number of nests must be observed at frequent intervals. Some species, because of rarity or secretiveness, may never be known in detail.

However, it is possible, with proper caution, to use less complete observations to indicate whether a species appears to fit the general conclusions about other species derived from very extensive studies. In any event, gross differences may often be detected by analysis of a small number of observations.

A little reflection will make it apparent that analysis of a problem occurs by a series of refinements of handling of data. Suppose we ask the question, "Does the clutch-size of Eastern Kingbirds decline during the breeding season?" A crude answer can be given by merely noting that clutches found in June usually have 4 eggs while those in July usually have 3 eggs. A more refined answer can be given by analyzing statistically a number of clutches to determine the significance of the differences in each month. A still more refined answer can be given by waiting until many hundreds of nests have been found and analyzing the clutch-size for each day. Other refinements may then be explored, such as grouping for temperature and age of bird.

A compromise, however, can be made between the crude answer and the ultimate refinements by using the type of miscellaneous data accumulated by most bird watchers in their ordinary activities. These data are frequently adequate to indicate whether or not the breeding biology of a species agrees with that of other species. In other cases these data may suggest that a particular species merits a detailed study of some aspect of its breeding biology.

For a variety of reasons nests found by bird watchers may be examined only once or twice. At present data thus obtained lie unused in notebooks in spite of the fact that limited conclusions can be drawn. Consider, for example, clutch-size. It is perfectly obvious that a clutch in a nest observed only once is imperfectly known. However, if the eggs are warm the clutch is being incubated. The observer may assume it to be complete, but some eggs may have been removed by a predator or by cowbirds. But this same objection can be made to studies in which the nest is observed daily because a predator might remove the last egg of a clutch between the time it is laid and the time the observer arrives. The difference in accuracy is merely a matter of degree. A slight overestimate will occur because 2-egg clutches will often be considered incomplete and hence omitted. Therefore, it is permissible to use such miscellaneous observations for the detection of gross changes.

The observations to be analyzed for breeding are the pertinent data for each nest: date, place, number of eggs or young, location as to height and type of tree or site, and any other special points. An arbitrary rule may be established that if the young are hatching (for example, 2 eggs and 2 young), the nest may be counted as having eggs, not young (4 "eggs" in this case). The data should be organized into tables of frequency distributions.

A problem at once arises in the dating of the clutch, since one common objective is to find out whether or not a decline occurs during the breeding season. From one record an observer knows merely that the clutch was begun, for passerine birds, within about 16 to 20 days prior to the date of observation. On the average clutches are completed about 6 to 8 days before found. Thus, a clutch found on July 2 might be listed for the first half of July, although the chances are good that it was completed in late June. However, barring the vagaries of random sampling, the same errors will occur for other half months and the clutches will be on the average listed according to the actual time sequence. The average size of clutches therefore, relates to a time about 6 to 8 days before the eggs were found.

Table 1

Nesting Data on Kingbirds

	Period of time[1]			
	Last half of June	First half of July	Last half of July	Totals
Number of eggs	39	50	12	101
Nests with 2 eggs	0	(2)	0	(2)
" " 3 "	1	10	4	15
" " 4 "	9	4	0	13
Total nests	10	16	4	30
Mean number of eggs	3.9	3.3[2]	3.0	3.5[2]
Per cent[3]	33	53	14	....
Number of young	4	64	18	86
Nests with 0 young	0	2	3	5
" " 1 "	0	1	1	2
" " 2 "	0	0	1	1
" " 3 "	0	9	5	14
" " 4 "	1	9	0	10
Total nests	1	21	10	32
Mean number of young	4.0	3.1	1.8	2.7
Per cent[3]	3	66	31	....

[1] A nest was assigned to the time period in which it was found (see text).
[2] The two nests with 2 eggs were excluded because it was known that magpies had destroyed some eggs.
[3] The percentage of total nests with eggs or young found in the respective periods.

RESULTS FOR KINGBIRDS

Observations of nests were obtained in the neighborhood of Flathead Lake, in western Montana in the four summers from 1950 to 1953, inclusive. The data in table 1 are grouped by clutch-sizes and number of young per nest according to the half month in which the nest was found. It is at once apparent that the clutch-size declined in the observed sample. The peak of laying is about July 1 (subtracting 8 days from the midpoint of the first half because incubation is 16 days). The peak percentage of nests with young is clearly later than the peak for nests with eggs. The number of young per nest also declines as the season progresses. The probability of hatching can be obtained by dividing the number of young per nest by the eggs per clutch or $2.7/3.5 = 0.8$.

A number of flaws are at once apparent. For example, the two clutches of two eggs had almost certainly lost some eggs to magpies. Perhaps some of the 3-egg clutches had, also. The five nests with no young were known to have lost all their young because two observations were made at suitable intervals. Other empty nests were found but could

not be used since it was not known whether young had flown or had been destroyed. The estimate of hatch refers really only to "successful" nests, that is, to nests in which at least one egg hatches. Unsuccessful nests can rarely be distinguished from nests from which the young have flown.

The statistical significance of these differences has not been examined because the numbers are too small to establish a difference if it exists. The type of conclusions to be drawn below permit this omission.

Some other observations merit mention. Half of 70 nests were over water. The heights of the nests are given in table 2. The mean is 4.3 yards and 50 per cent were less than 3 yards above ground (or water). The species of tree was recorded for 54 nests of which 21 were in thorn trees, 10 in willows or alders, 5 in poplar, 4 in juniper, 3 in apple, 2 in locusts, 2 on light poles, 2 on houses, 1 on a fence post, 2 on a pile of boards, and 1 each in rose bush, box elder, and cherry. The frequency of thorn trees is a reflection of their abundance along water. The site was noted in 65 cases of which 33 were out on a limb, 14 were on a dead stub in the water, 10 were in crotches and the rest in bushes, light poles, etc.

Table 2

Height of Eastern Kingbird Nests Above Ground

Yards	Nests	Cumulative Per cent
0	4	5.6
1	15	26.6
2	15	47.7
3	5	54.7
4	5	61.7
5	8	72.9
6	4	78.5
7	4	84.1
8	3	88.3
9	4	93.9
10	4	99.5
	71	

The critical point in a discussion of data of this type is the care in drawing conclusions. For example, these data are not expected to establish that clutch-size in Eastern Kingbirds declines as the season progresses but they do show that in one sample the size declined in about the same way as has been established for several thoroughly studied species such as the American Goldfinch (Stokes, Wilson Bull., 49, 1950:107–127). Hence, it can be concluded that the chances are good that clutch-size in Kingbirds declines about the same as in other species. Or, to say it another way, this sample agrees with the type of decline found in other species and that nothing unusual, such as an increase, is to be expected in this species in this region. Similarly guarded statements may be made about the time of the peak of laying and the per cent hatch.

As stated in the introduction, the crudity of the data permits only crude conclusions but these may be adequate for present purposes. This method is no substitute for thorough studies but would permit a rapid survey of species and places in respect to several problems of breeding biology and would suggest important species or problems for intensive study.

A check on the method may be made by comparing the results of a thorough study

with those from miscellaneous observations. For this purpose the detailed study of American Robins (*Turdus migratorius*) by Howell (Amer. Midl. Nat., 28, 1942:529-604) can be compared with the nest records on file at the Patuxent Research Refuge. I am indebted to Dr. Howell for a tabulation of his original data and to Mr. Chandler Robbins for guidance in the use of the nesting cards. The data are tabulated in table 3 for comparison. The dates are calculated in two ways so that allowance can be made for later initiation of breeding in New York than in Maryland where three nests were found before April 15.

Table 3

Clutch-size of Robins in Maryland and New York[1]

Dates	Maryland		New York		Dates	Maryland		New York	
	Number of nests	Mean Clutch size	Number of nests	Mean Clutch size		Number of nests	Mean Clutch size	Number of nests	Mean Clutch size
April 1–15	3	3.33	0	.....	April 1–30	15	3.40	23	3.70
April 16–May 15	36	3.50	43	3.68	May 1–31	54	3.54	38	3.50
May 16–June 15	37	3.48	25	3.36	June 1–30	20	3.24	11	3.36
June 16–July 15	14	3.14	7	3.14	July 1–31	2	2.50	3	3.00
July 16–31	1	.....	0	.....					
Total	91	3.42	75	3.52		91	3.42	75	3.52

[1] The data are grouped in two ways; see text.

A decline in clutch-size is apparent in both sets of data, demonstrating that at least in this case a carefully collected set of data (New York) shows the same trend as a miscellaneous set of data (Maryland).

The table raises some interesting questions. It will be noted that the average number is very similar by dates in New York and in Maryland except at the start. Yet the breeding season is shorter in New York. The question can be asked, "Do Robins at different latitudes lay the same number of eggs on the same dates?"

Another set of questions arises from a consideration of clutch-size. The New York average is larger (but not significantly; S.D. = 0.58 for each, P = .72) than that from Maryland. It is generally accepted that birds lay larger clutches in the northern part of their range than in the southern. The present data permit no conclusions but merely raise questions. Note that the clutches for April 1–15 in Maryland averaged only 3.33. A low initial clutch-size has been found for several species. Is it possible that the reason clutch-size is frequently smaller in southern than in northern areas lies in the early beginning of the breeding season in southern areas at a time when clutch-size is small?

The discussion of these aspects has been prolonged to emphasize the fact that miscellaneous data of the type every bird-watcher has in his notebooks can be very useful for raising questions about breeding biology and starting study to obtain answers. Also, in particular the discussion of the data on the American Robin shows that a number of important results could be obtained from a large number (400 each) of nests from two areas.

I am indebted to the Montana State University Biological Station for the opportunity to collect the data on kingbirds.

SUMMARY

Nesting data for Eastern Kingbirds collected from 1950 to 1953, at Flathead Lake, Montana, indicate that a decline in clutch size may occur during the breeding season. The mean number of eggs in 30 nests was 3.5 and the mean number of young in 32 nests was 2.7. Half of 70 nests were over water and half were placed at a height of less than three yards. Problems and methods of interpretations of limited data are discussed.

A comparison of results of complete data for American Robins in New York (Howell) with miscellaneous data for this species from Maryland shows that the method gives reasonable results in this case. Also a number of interesting problems concerning the clutch-size of robins is suggested.

Division of Vertebrate Ecology, The Johns Hopkins School of Hygiene and Public Health, Baltimore, Maryland, January 17, 1955.

A HYBRID BETWEEN THE SPRUCE GROUSE AND THE BLUE GROUSE

By M. JOLLIE

A hybrid between the Spruce Grouse (*Canachites canadensis franklini*) and the Blue Grouse (*Dendragapus obscurus richardsonii*) was taken on November 12, 1950, at a road cut along Mannering Creek one and one-half miles south of Emida Summit, or about six miles south-southwest of Emida, Benewah County, Idaho. The area is covered by a heavy forest of white pine, Douglas fir, red cedar and other conifers and lies at about 3200 feet. In this area the Ruffed Grouse is common but neither the Spruce Grouse or the Blue Grouse has been seen by the writer, nor has either been reported by Johnston (Condor, 54, 1949:140-149) who censused a nearby area. Both parent species of the hybrid probably occur on the higher ridges where more suitable habitat is to be found.

Hybrids between species of gallinaceous birds are rare in the wild but common in captivity. Although many crosses in grouse are known, this particular combination has not yet been reported (Cockrum, Wilson Bull., 64, 1952:140-159). In the description of this hybrid I prefer to consider the Franklin Grouse as a subspecies of the Spruce Grouse since these two forms are only superficially separable and even in the most conservative view must be considered as parts of a single superspecies.

The specimen (fig. 1) is a male which has completed its postjuvenal molt. Extensive material for comparison is lacking, but single examples of males of both parent species in the immature and adult plumages are available. Other specimens of the Blue Grouse, of both sexes and all ages but without data on weight, are included in the comparative material.

Table 1 gives some impression of the comparative sizes of the parent species and the hybrid, although the range of variation is not given. Generally speaking the hybrid is about midway in size between the Spruce Grouse and the Blue Grouse. The bill is large, however, equalling that of the Blue Grouse. The number of tail feathers (18) is exactly intermediate between that of the Spruce Grouse (16) and the Blue Grouse (20).

Table 1

Measurements of Spruce Grouse, Blue Grouse, and a Hybrid Between the Two

		Spruce Grouse		Blue Grouse	
	Hybrid	Immature	Adult	Immature	Adult
Weight	850 gms.	525 gms.	500 gms.	1075 gms.	1310 gms.
Length of wing	222 mm.	188 mm.	188 mm.	237 mm.	245 mm.
Length of tail	140 mm.	145 mm.	140 mm.	165 mm.	185 mm.

The coloration and markings of the plumage are more like the Spruce Grouse than the Blue Grouse but the general dilution of color suggests the effect of the latter species. The feathers of the narial region are black like those of the Spruce Grouse. The top of the head is gray, about midway in tone between the two species but lacking most of the brown wash of either; a similar gray is observed in some adult females of the Blue Grouse. The bases of the feathers of the crown are black as in the Spruce Grouse. The skin over the eye is crimson in the Spruce Grouse, yellow in the Blue Grouse and orange in the hybrid.

The back is like that of the Spruce Grouse; the primaries, however, show mottling

Fig. 1. Male hybrid between Spruce Grouse and Blue Grouse taken in Idaho. Drawing by M. Jollie.

along the outer margins, as does the Blue Grouse. The rump is like the Spruce Grouse in tone but lacks the heavy cross-barring; it has much finer, irregular barring but does not resemble the Blue Grouse in this feature. The tail is midway in tone; the feathers are rounded at the tip like those of the Blue Grouse and they have a terminal gray band which ranges from 10 mm. wide on the center feathers to 5 mm. on the outer feathers. This terminal band is of interest because it is lacking in both the parent forms although such a band does occur in the typical Spruce Grouse and in some subspecies of the Blue Grouse.

The throat is darker than that of the Blue Grouse but shows the intermixture of the white bases of the feathers more than does that of the Spruce Grouse. The rest of the underside is closer to that of the Spruce Grouse than to the Blue Grouse. The feathers at the side of the neck, just in front of the wing, do not show the white bases so characteristic of the male Blue Grouse. The male Blue Grouse has a bare patch of skin on the

side of the neck which covers a vocal sac; this patch of skin is surrounded by these white based feathers. The Spruce Grouse lacks vocal sacs. Unfortunately, in preparing the hybrid specimen no note was made of the presence or absence of the vocal sacs.

The black shoulder band of the Spruce Grouse which connects with the black (chaetura drab or black) chest is well marked in the hybrid. The belly tone is about midway between the parent species with the result that the white tips of the feathers are not as sharply marked as in the Spruce Grouse. Like the Spruce Grouse the feathers of the sides are drab with black irregular barring; they have a white tip with a white shaft streak. The feathers of the flank, shank, and undertail regions are also like those of the Spruce Grouse.

University of Idaho, Moscow, Idaho, January 6, 1955.

THE PURPLE SANDPIPER IN SOUTHERN BAFFIN ISLAND

By GEORGE M. SUTTON and DAVID F. PARMELEE

The Purple Sandpiper (*Erolia maritima*) breeds locally, in small numbers, in southern Baffin Island in the American arctic. Soper (1928:98) informs us that "specimens and eggs were taken by the MacMillan expedition to southwest Baffin Island, 1921–1922." Bent (1927:146) mentions two sets of eggs "collected with the parent bird at Cape Dorset" that were given to him by MacMillan. Whether or not these were the "specimens and eggs" referred to by Soper, we hasten to say that they probably came not from Cape Dorset proper, but from somewhere in the interior of Foxe Peninsula, perhaps many miles from the coast. Kumlien (1879:87) saw "hundreds" of Purple Sandpipers in Cumberland Sound in spring. Soper (1946:228) believed that "a few scattered individuals" bred along Blue Goose River and about Bowman Bay. He reported nests and eggs found by an Eskimo assistant "in moist, grassy depressions about lakes far inland, northwest of Crooks Inlet" in the Lake Harbour area.

Taverner's statement (1934:122) that the species is "more at home on rugged, rock-bound seacoasts than on low, tidal flats" applies to migrating flocks, wintering populations, and scattered individuals or groups undergoing the postnuptial molt. As a breeding bird, *Erolia maritima* forsakes the rocks entirely and lives on the tundra instead, placing its nest "in peat" or "among moss-grown shingle" (Witherby *et al.*, 1948:274).

During the earlier part of our summer sojourn on Baffin Island in 1953 we looked in vain for the Purple Sandpiper. Our headquarters were at latitude 63° 45′ N, longitude 68° 33′ W, at a Royal Canadian Air Force Base near the head of Frobisher Bay. The lowlands near the base were snow-free when we started our work on June 14, and we expected to find many shorebirds courting or breeding there, as well as on Davidson Point, a rock-rimmed expanse of marshy land near the mouth of the Sylvia Grinnell River situated a mile or so west of the base. The only shorebird we saw regularly was the Semipalmated Plover (*Charadrius semipalmatus*). The bay was ice-bound until early in July. Whenever the tide went out a vast area of mud and several rocky islets were exposed, but even here we failed to find Purple Sandpipers.

From July 17 to 20, on extensive grassy flats near the mouth of the Jordan River, 16 miles west of the base, we found a few Semipalmated Plovers and Semipalmated Sandpipers (*Ereunetes pusillus*) and a very few White-rumped Sandpipers (*Erolia fuscicollis*) nesting, but we failed to find either the Purple or the Baird Sandpiper (*Erolia bairdii*) there. Nor did we find these two last-named species at latitude 68° 31′ N, longitude 71° 22′ W, near a large lake 50 miles east-northeast of Wordie Bay, on August 8, or at latitude 65° 20′ N, longitude 77° 10′ W, near Cape Dorchester, on August 11.

We first recorded *Erolia maritima* on July 29, on a low rocky islet near Coffin Island, about 15 miles south of the base. Here, at low tide, in a wide, dark, seaweed-lined cavern, sheltered from the wind by huge slabs of rotten, deeply pitted ice, we came upon two Purple Sandpipers feeding. Their short, grating calls startled us as the birds flitted up and over the ice. They alighted not far from our boat and an Eskimo shot one. We visited several islands in the vicinity looking for more Purple Sandpipers, but we failed to find any. Nor did we find Purple Sandpiper remains below a Peregrine (*Falco peregrinus*) eyrie on the largest island of the group. The specimen collected (G.M.S. 11794) proved to be a female in breeding plumage. There were distinct brood patches. The largest ova were considerably less than a millimeter in diameter. The stomach contained small bits of gravel and snail shell. The bill was orange-brown at the base and dark

grayish olive otherwise; the legs and toes were dull brownish yellow and the eyes were dark brown. Examination of the plumage and inside surface of the skin revealed no pin feathers. The wing and tail molt had not yet started; but a large patch of gray and comparatively unmarked feathers on the chest appeared to belong to the winter plumage. Where this bird had nested, whether it had left the tundra early as a result of nest-failure, whether it had completed its molt into the breeding plumage or whether, indeed, it had nested at all that summer, we could not say. All we knew was that its general appearance was that of a breeding bird, and that two brood patches were distinct. These lay along each side of the belly and were not part of the ventral apterium. Each patch was enlarged fore and aft, as if to accommodate an egg at each end.

On August 2, Brendan Halloran and an Eskimo visited certain rocky islets not far from the Hudson's Bay Company post and saw several Purple Sandpipers.

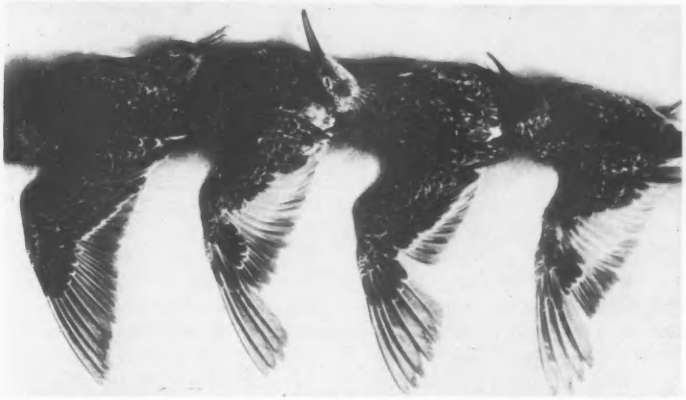

Fig. 1. Unskinned adult female Purple Sandpipers collected from the same flock near head of Frobisher Bay, Baffin Island, on August 6, 1953. The bird at the left has unmolted remiges; in two specimens white bases of the secondaries show plainly because many greater secondary coverts have dropped out. Left to right: GMS nos. 11814, 11815, 11817, 11816.

On August 6, we hunted Purple Sandpipers by boat. At several stops we failed to find the species; but on a rocky island five miles south of Tarr Inlet we came upon a flock of six from which we collected five specimens, all females, each with well defined ovary and two brood patches (G.M.S. 11813–7). In two specimens no wing-molt was apparent; but in three of them many primaries were being replaced. The molt was proceeding from the innermost primary outward (see fig. 1). Only one specimen was fat; in this individual the remiges and body plumage were molting heavily. The birds had been feeding on small snails.

Every specimen handled by us thus far was a female. Our collecting was not selective—we shot what birds we could, assuming that some would be males. The statement by Witherby *et al.* (*loc. cit.*) that incubation is performed "chiefly by male, but apparently female takes some part," leads us to wonder whether the females leave the breeding ground in advance of the males, molting and possibly even migrating separately from them. Salomonsen (1951:235) states that "only the male broods the eggs, accord-

ing to the sex of a number of sitting birds shot in W. Greenland." Trevor-Battye (1897: 590), states that specimens from Spitsbergen "obtained off the eggs themselves were, with one exception, males; and there can be no doubt that the greater part of the hatching is done by the male." If the female does not brood the eggs, then why the well defined brood patches in all the Baffin Island specimens thus far mentioned? Our belief is that had females been collected in West Greenland and Spitsbergen, examination of them would have revealed brood patches, or that had incubating birds been shot on the nest at various times of day and night, some of them would have proved to be females. This matter should be investigated further, especially in the light of what we are able further to report.

When, on August 8, at latitude 64° 38′ N, longitude 70° 28′ W, along the southeast shore of Lake Amadjuak, we at last found the Purple Sandpiper on its nesting ground, we avidly sought adult male specimens. We saw two birds that day, both adults. One was flying above a long, narrow gravel bar and the other was on the tundra, several hundred yards from water, running about with head low and plumage puffed out, calling excitedly (see Nicholson, 1930:409). We tried to find young birds, but in vain. Finally we collected the adult. It proved to be a female (G.M.S. 11819). Its inner primaries were molting, the outermost of the molting group being very short. The two brood patches were distinct.

The area in which we found this bird was tundra of an unusual sort. Walking was difficult, for the ground was muddy, although there was some gravel and the surface appeared to be firm. The whole place had a grassy or mossy appearance at a distance; but at close range the bare strips between the patches of verdure showed plainly. Walking on the vegetation did not help; the foot sank several inches at every step.

In this same area on August 15, we collected two young Purple Sandpipers, both short-winged and short-tailed, but able to fly well. Their call-note we jotted down as *tee-tee* or *weep-weep*. Both proved to be males (G.M.S. 11841–2). One was more downy on the head, both above and below, than the other. They were the only Purple Sandpipers we saw in that area. In another place, a mile away and a half a mile from water, we came upon two more Purple Sandpipers, an agitated adult, which we failed to obtain, and a young bird, which we collected (female, G.M.S. 11843). In all these young birds the chest and sides were spotted rather than streaked. The bills were dusky with yellowish olive base and the feet were dull brown with an orange tinge.

We did not see a Purple Sandpiper anywhere after August 15.

DESCRIPTION OF ADULT SPECIMENS

Our seven adult specimens, all females, are alike in one respect; they are not in a complete plumage of any sort. The mixture of plumages is especially noticeable on the chest and lower foreneck, where many of the feathers are brownish gray, inconspicuously edged with grayish white, and where there is a sprinkling of dark-centered feathers. As for the "sooty-brown" breast and the "large oval sooty-brown spots" of the lower breast referred to by Witherby *et al.* (1948:275), there is much individual variation (see fig. 2).

The series is uniform in that the neck proper, both in front and behind, is clearly streaked. Every bird has very dark scapulars and back plumage, the feathers being so worn that very little white, buff, or rufous remains. Every bird is dark-crowned except G.M.S. 11815, which was molting heavily. Here the whole head, except for the chin, throat and eye-ring, is largely smooth gray, that is, it is in fresh winter plumage.

Salomonsen (1951:230–231) believes that *Erolia maritima groenlandica* (Lφven-

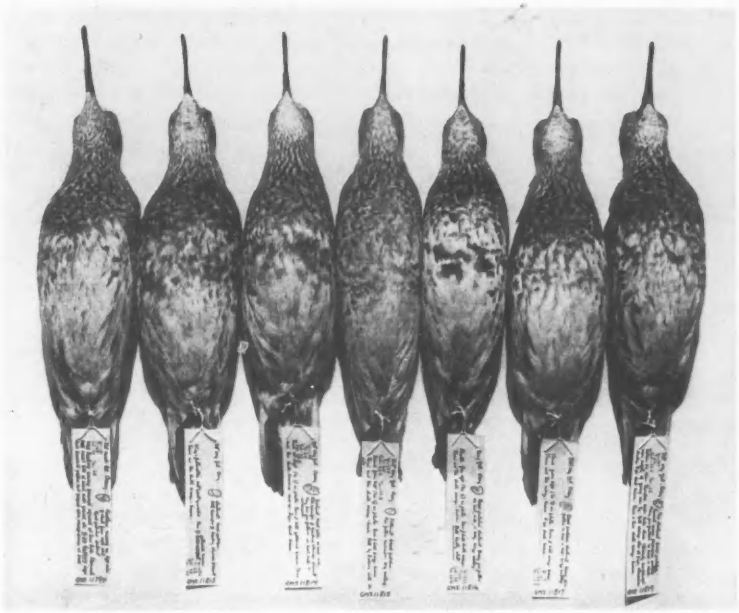

Fig. 2. Adult female Purple Sandpipers collected in southern Baffin Island in the summer of 1953. The bird at the right was taken on the tundra near Lake Amadjuak; the others are from rocky islands at head of Frobisher Bay. The three birds at the left are the only ones having unmolted remiges. Left to right: GMS nos. 11794, 11813, 11814, 11815, 11816, 11817, 11819.

skjold), allegedly of Greenland and Iceland, is not separable from the form found in Scandinavia and Spitsbergen. His measurements of specimens from Greenland, Scandinavia, Iceland, and the Faroes show the Iceland birds (51 males, 36 females) to be noticeably large, but his measurements reveal so much overlapping that he believes recognition of the large race is not warranted. Our Baffin Island adult females measure as follows (in millimeters):

G.M.S. no.	Date	Wing	Tail	Culmen	Tarsus
11794	July 29	131	64	37	24
11813	August 6	130	63	33	23
11814		128	64	33	22.5
11815		127	64	32.5	23.5
11816		125	....	33	23.5
11817		131	61	34.5	23.5
11819	August 8	127	62	33.5	23

ACKNOWLEDGEMENTS

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pany, for helping us to reach certain islands in Frobisher Bay, Constables Robert Van Norman and Robert Pilot, of the Royal Canadian Mounted Police, for taking us by boat to the mouth of the Jordan River, and personnel of the Royal Canadian Air Force for permitting us to accompany them on flights to remote parts of southern Baffin Island.

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Department of Zoology, University of Oklahoma, Norman, Oklahoma, January 14, 1955.

HEART WEIGHT IN BIRDS

By FRANK A. HARTMAN

Since the heart is the source of power for the circulation, its relative size indicates the capacity to move the blood. Determinations of heart weights in relation to body weights have been made in vertebrates, especially birds, by a number of investigators over the years. Many of the values reported have been based on single specimens and a majority are Old World species.

In collecting material for other studies we have accumulated a considerable amount of data on the heart weights of birds taken in the United States and Panamá. Our material confirms some of the old ideas and suggests problems for further research. Moreover, data on many birds not published hitherto are recorded.

METHODS

All except small birds were weighed in the field soon after shooting, on one of the following Chatillon spring balances, the most sensitive one for the weight involved being used: 6000 grams capacity with 24 grams sensitivity; 2000 grams capacity with 25 grams sensitivity; 500 grams capacity with 10 grams sensitivity; 100 grams capacity with 0.25 grams sensitivity (a very long balance, made for the purpose). Small birds were weighed at camp on a torsion balance of 120 grams capacity and 2 mgm. sensitivity.

While in the field, immediately after weighing, the birds were enclosed in plastic bags to prevent drying. In camp the hearts were removed after cutting the blood vessels close to the organ. Blood was expressed by gentle pressure on cotton or filter paper through slits in the ventricles. Weighings were made immediately either on the torsion balance or, in the case of hearts little more than a gram in weight, on a Roller-Smith balance with a capacity of 1500 mg. and sensitivity to 0.02 mg. All weights are from adult birds unless otherwise stated. None but healthy, well nourished birds were used.

Nomenclature is based largely on Peters' check-list (1931–1951) and on the check-list of the American Ornithologists' Union (1931) for North American passerine species.

All Panamanian birds were collected during the dry season, January through March, at the following stations: Juan Mina on the Chagres River; La Jagua River east of Panama City; Mount Copete (7000 feet) above Boquete; Palo Santa near the village of El Volcán (4000 feet); and Santa Clara, 15 miles from the Costa Rican border on the Pan-American highway (4500 feet). Florida birds were collected in January and February or June and July on Lake Okeechobee, in the Everglades, around islands off the Gulf coast, and on the prairies of the peninsula. Birds from Maine were obtained at Lake Kezar in June, July, August and September. Birds from Ohio were collected at various times throughout the year. Most specimens were obtained in the morning before 11 a.m. or in the late afternoon.

ACKNOWLEDGMENTS

First we wish to thank Dr. Michael M. Clay for calculating many of the data. We are very much indebted to Mr. Richard Archbold of the Archbold Biological Station, Florida, for his personal assistance in the collection of material and for the use of the facilities of the Archbold Biological Station. In Panamá our studies in the Canal Zone were based at the Juan Mina Field Station of the Gorgas Memorial Institute through the good offices of Dr. H. C. Clark. Mr. Pablo Brackney kindly granted us the use of a cottage at El Volcán and Mr. Toliffe Mönniche aided us on our expedition on Mount

Copete above Boquete. Mr. James Zetek at the Barro Colorado Island Laboratory was very helpful at all times with invaluable advice. Above all we wish to thank Dr. Alexander Wetmore for the identification of most of the Panamanian birds. This study was aided by grants from the Comly Fund and the Graduate School of the Ohio State University.

RESULTS

More than 1340 hearts were weighed among 291 species and subspecies in 64 families. The percentage of heart weights were calculated using body weights from the respective individuals from which the hearts were obtained. The list (p. 227 ff.) shows the number of individuals in each species, the mean values, standard errors of the means, or the individual values if the series is small. Sexes are separated for body weights but not for hearts. Representative members of each family are plotted in figure 1, the scales being logarithmic, the heart weights being in milligrams and the body weights being in grams. The species starred in the list are shown in figure 1.

It can be noted in the figure that the values tend to follow a straight line down to a body weight of about 200 grams and then follow another less steep line below this value.

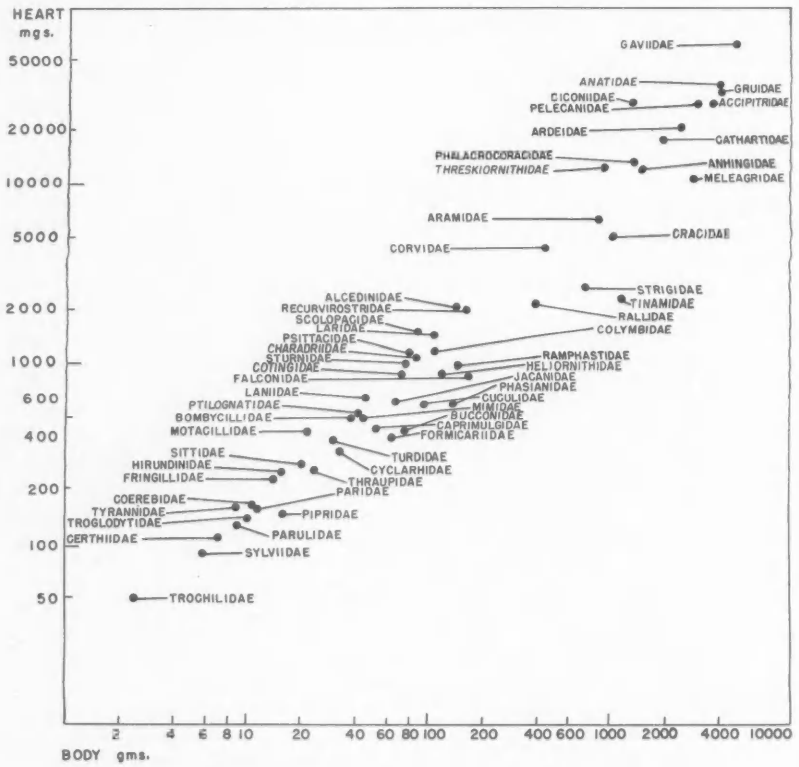

Fig. 1. Selected plottings of heart weights against body weights (log scales).

In other words, smaller birds have relatively larger hearts than do larger birds. With exceptions to be discussed, the bird heart seems to follow a logarithmic relationship to body size. Deviations from this can best be noted in the list.

Among the families there are great differences, the heart weight ranging from a little more than 0.2 per cent to 2.4 per cent of the body. Wide differences may be found between species in the same family. Differences between closely related species may appear to be significant but further data and analysis may prove them not to be.

The tinamous have relatively the smallest hearts of all birds, 0.2 per cent or slightly above. Following down the list, the pelican appears to have a smaller heart than the cormorant but the difference is questionably significant ($P<0.05$). Anhinga hearts are significantly larger than those of the pelican ($P<0.01$). Among the herons there was a significant difference between hearts of the Great Blue Heron of Florida and those of the Louisiana Heron, the latter being larger ($P<0.01$). These last were about the same percentage weight as those of the Anhinga. Among the anatids the heart of *Nomonyx* is much larger than that of other ducks weighed, even *Aythya* ($P<0.01$). There was a significant difference between the hearts of two vultures, those of the Black Vulture being larger than those of the Turkey Vulture ($P<0.01$).

Specimens of the Bald Eagle taken in Florida were young birds which had never been permitted to fly although they were fully feathered. They were but a few months old. The hearts of the Bob-white and Wild Turkey collected in Florida were among the smallest of all birds studied (0.40 per cent of the body). Shore-birds had hearts that were among the largest; especially was this true of the Ruddy Turnstone and the Short-billed Dowitcher. Among the larids the heart of the Roseate Tern is significantly larger than that of the Common Tern ($P<0.01$). Although our data are limited, hearts of columbids showed a considerable range in size, some being among the smallest. In the psittacids the parakeet *Pyrrhura* possessed the largest heart although two specimens of *Brotogeris* had hearts just as large. The cuculids had small hearts as did the large strigids while the Burrowing Owl of Florida possessed a larger heart. The trochilids possessed the largest hearts of all birds. The hearts of kingfishers were fairly large, being 1.25 to 1.39 per cent of the body. Toucans with hearts 0.65 to 0.74 per cent of the body were among those with small hearts. Picid hearts varied greatly in size, those of the smaller species being relatively larger.

The range of heart size was great among the formicarids, being from about 0.57 (*Taraba major*) to 1.16 per cent (*Dysithamnus*) of the body. The range among the dendrocolaptids was still greater, being from 0.78 per cent to 1.61 per cent. The hearts of the swallows were among the largest. The hearts of the Cedar Waxwing and Red-eyed Vireo were especially large (1.55 per cent). The larger heart of the Red-eyed Vireo compared with that of the White-eyed Vireo was of questionable significance since $P<0.05$. The largest parulid, the Chat, possessed one of the smallest hearts in this family (1.01 per cent). In the tanagers the heart values tended to be low, few being more than 1.30 per cent and half of them less than 1.0 per cent. These differences may be too great to be explained by body size.

Obviously there are factors other than body size that influence the relative size of the heart. These may be sex, age, activity, season, climate and altitude. We shall consider these in turn and in the terminal discussion.

Sex.—Heart percentages were separated as to sex in all preliminary calculations, but since no significant differences were found all values were combined. Even in those species which show considerable sexual difference in the body weight, the heart is of the same relative size. For example, among the icterids we have the following data:

	Sex	Body weights in grams	Number	Heart percentage
Sturnella magna	♀	76.0±3.2	4	1.09±0.071
	♂	101.5±2.5	14	1.16±0.026
Cassidix mexicanus	♀	98.0±3.3	3	0.97
	♂	185.8±7.7	6	1.02
Agelaius phoeniceus	♀	30.3	2	1.13
	♂	48.7	2	1.06

Age.—Heart weights were determined in nestlings of a few species. A large series of Brown Pelicans only a few weeks of age and ranging in weight from 1100 to 3600 grams had the same relative heart weight as the adults (see list, p. 227). Even the hearts of very young pelicans, 1100 to 1500 grams in weight, had practically the same range (mean, 0.84 per cent) as the remaining 64 weighing from 1600 to 3600 grams (mean, 0.81 per cent). Furthermore, there was no difference between sexes. Also a considerable series of young Double-crested Cormorants was weighed, ranging in size between 675 and 1500 grams. The relatively larger value for the hearts in the adult birds was of questionable significance since $P<0.05$.

In addition to the adult Great Blue Herons three very young birds from the same nest were weighed. Their body weights and heart percentages were: 575 grams, 0.76 per cent; 1300 grams, 0.78 per cent; and 1550 grams, 0.85 per cent. The first two were appreciably smaller than the mean for the eight adults ($P<0.01$).

Four young Common Terns not included in the list gave a greater range in relative size of the hearts than did the adults. Their bodies weighed 63, 73, 86, and 87 grams while their hearts were, respectively, 0.79, 1.26, 1.16, and 0.89 per cent. One half-grown pigeon (*Columba albilinea*; 140 gm.) possessed a smaller heart (0.52 per cent) relatively than the adults (1.09 per cent).

Two nestling Striped Horned Owls possessed hearts approximately the same relative size as the adult. Three young specimens (160, 190, and 200 grams, body weight) of the Pileated Woodpecker of Florida from the same nest had relatively smaller hearts than did the adult (0.67, 0.76, and 0.79 per cent as against 0.98 per cent, respectively).

One young Red-eyed Towhee (38.1 grams) possessed a much smaller heart (0.60 per cent) than the adult. Two young Swamp Sparrows (15.9 and 16.5 grams) that could fly had hearts somewhat smaller (0.95 and 0.99 per cent) than the adults (1.19 per cent) whereas a young Song Sparrow weighing 20.2 grams possessed a heart 1.04 per cent of the body compared to 1.18 per cent for the adults. However, birds not nearly grown sometimes possessed hearts of almost the same relative size as adults. The heart of a female Mourning Dove weighing only 47 grams was 1.08 per cent of the body. One young Cowbird weighing 31.5 grams possessed a heart only 1.07 per cent of the body weight. Occasionally fully fledged birds of the year (cranial bones still soft) have been weighed, and their hearts have been found to be adult in size relative to the body.

More information is needed as to the relative size of the heart at different ages in the growth of the young birds for different species. The magnitude of the difference may be expected to vary in different species.

Activity.—Activity may have an important influence on heart size. Thus, trochilids, among the most active of birds, have by far the largest hearts (Hartman, 1954, and list). Likewise many other small birds are more active than larger birds. Among the relatively large hearts are those of the parulids, certhiids, parids, vireonids, and hirundinids. Equally large in relation to size were the hearts of some charadriids, scolopacids and recurvirostrids. These are rather active birds and not very large.

Among the parulids the heart ranges extended from a little more than 1 per cent to 1.58 per cent, being lowest in the Chat. This low value may be of questionable signifi-

cance, however, P for the difference between the Chat and the Redstart being <0.05. The latter species is smaller and more active than the former. In the icterids the heart range is great, varying from 0.62 to 1.49 per cent. The Cowbird has a relatively larger heart than does the Meadowlark ($P<0.01$) or the Boat-tailed Grackle ($P<0.01$). Fringillids show differences that might be attributed to activity and size. The Indigo Bunting possesses a larger heart in relation to the body weight than does the Towhee ($P<0.01$). The heart of the Savannah Sparrow is significantly larger than that of the Towhee ($P<0.01$), but the heart of the Savannah Sparrow is not larger than that of the Swamp Sparrow, according to our data, t being 2.0 (5 per cent = 2.20).

The smaller woodpeckers possess somewhat larger hearts than do the large ones. The hearts of the Yellow-bellied Sapsucker and Downy Woodpecker were among the largest. The hearts of kingfishers were fairly large, being 1.25 to 1.39 per cent of the body. These birds are quite active.

Seasonal variation.—Although we do not have enough data on any one species for adequate proof, the combined data from several species strongly indicate that the hearts are relatively lighter during the colder months of the year in some species. This is shown in table 1.

In nine species the difference was too small to indicate a definite trend or there was no difference, as the following examples show. Green Herons taken in Florida showed an average of 0.916 per cent for the heart in six specimens collected in January, February, and March whereas the average of the heart in five specimens collected in April, May, and June was 0.956 per cent. Turkey Vultures from Florida showed an average of 0.68 per cent for the heart in seven specimens collected in December, January, and February, whereas five specimens collected in April and May had hearts averaging 0.75 per cent of the body weight. Six specimens of Killdeer collected during February in Florida had hearts averaging 1.31 per cent of the body weight, whereas two specimens collected during June in Ohio had hearts averaging 1.49 per cent. The difference is not significant since the range is too great for the small number of individuals. Four specimens of the Red-bellied Woodpecker obtained in January had hearts averaging 1.09 per cent of the body weight whereas five collected in March, April, and October had hearts averaging 1.29 per cent. However, the range in each group is so great that the difference is not significant.

Table 1

Comparison of Heart/Body Ratio

Species	Cool season, November through March			Warm season, April through October		
	Body no.	Av. gm.	Heart Avge. per cent	Body no.	Av. gm.	Heart Avge. per cent
Fulica americana	2	594	0.59	1	485	0.80
Aramus pictus	1	89	0.65	1	85	0.82
Actitis macularia	1	38	0.95	1	45	1.16
Archilochus colubris	2	3.2	2.13	1	3.05	2.62
Dendrocopos borealis	5	39.8±0.62	1.21±0.05	3	52	1.38
Parus bicolor	1	22.2	1.31	4	22.4±0.6	1.65±0.15
Sitta carolinensis	4	20.48±0.69	1.22±0.004	3	20.3	1.47
Troglodytes aëdon	1	9.8	1.10	2	11.05	1.47
Dumetella carolinensis	1	37	0.73	1	42.4	1.18
Toxostoma rufum	1	59.5	0.87	2	70.4	1.08
Sialia sialis	9	31.11±3.17	1.18±0.04	2	30.5	1.36
Polioptila caerulea	1	5.5	1.14	2	5.5	1.48
Lanius ludovicianus	4	45.5±1.9	1.26±0.07	3	49	1.47
Richmondena c. cardinalis	3	43.3	1.16	3	41.4	1.53
Richmondena c. floridana	2	39	0.81	3	35.3	1.00
Spizella passerina	1	11.0	1.18	1	14	1.32

Four species possessed hearts of about the same percentage in cold and warm weather. In the Yellow-bellied Sapsucker one specimen collected in January had a heart that was 1.40 per cent of the body weight whereas three obtained in August and September also had an average of 1.40 per cent. Six winter specimens of Scrub Jay (January, February) had hearts averaging 1.04 per cent, and seven spring specimens (March and April) had hearts averaging 1.08 per cent. Two January specimens of Red-eyed Vireo had hearts that were 1.51 per cent of the body weight, and nine summer specimens (August, September) had hearts averaging 1.55 per cent of the body weight. The Towhees of Florida showed little difference in the winter (January, February) as compared with spring (March, April) specimens. Seven birds obtained in the first period possessed hearts that were 0.84 per cent of the body weight and six specimens collected in the latter period had hearts averaging 0.80 per cent. Ten January and February specimens of Eastern Meadowlark possessed hearts 1.18 per cent of the body weight, whereas eight April specimens had hearts 1.11 per cent of the body. The difference was not significant.

Thus, of 25 species for which we have seasonal data, 16 indicated relatively smaller hearts in cold weather and 9 showed insignficant or no differences. In general, when there is a difference, our data suggest that warm seasons are associated with larger hearts in the same species.

Climate.—A factor which might influence heart size is climate. However, this is difficult to evaluate because of complex inherent differences between species which obscure possible correlations with climate. However, there are a few subspecies or closely related species for which we have data. There is a significant difference in heart size between the Double-crested Cormorant of Florida and the Olivaceus Cormorant, the percentage values being 0.839 and 0.70, respectively ($P<0.01$). There may be a difference between the hearts of the northern and Floridan races of the Pileated Woodpecker. An average of 1.20 per cent for the former and 0.98 per cent for the latter indicates as much, but more data are needed. The difference between the hearts of the Black-capped Chickadee and the Carolina Chickadee may be significant ($P<0.05$). Likewise, hearts of *Vireo carmioli* are smaller (1.0 per cent) than those of all of the northern vireos (1.32 to 1.68 per cent). Two of the tropical wrens shown (*Thryothorus and Henicorhina*) have smaller hearts (0.72 to 0.93 per cent) than the northern members of the family (*Troglodytes* and *Telmatodytes,* 1.10 to 1.53 per cent). The Red-eyed Towhee has a questionably larger heart than that of the white-eyed race of the species in Florida (1.24 ± 0.14, compared to 0.843 ± 0.03 per cent; $P<0.05$). The hearts of the Florida race of the Cardinal are significantly smaller than hearts of the nominate race of Ohio ($P<0.01$). Thus, we see that our limited data indicate that the hearts of some species in warm climates are relatively smaller than those of related northern species.

Altitude.—In species which live at high altitudes the hearts may be larger than related forms found at lower levels. This may account for the larger heart (1.32 per cent) of the Quetzal as compared with other trogons. The heart of the former is questionably larger ($P<0.05$) than that of *T. massena* and significantly larger than that of *T. collaris* ($P<0.01$). The Quetzal rarely goes below 5000 feet whereas the others are found lower.

LIST OF BODY WEIGHTS AND RELATIVE WEIGHTS OF HEARTS

	Body weights in grams	Number of heart weights	Hearts as per cent of body weight
TINAMOUS			
Tinamus major (Pan.)	*2 ♀, 1140, 1175	2	0.195, 0.219
Nothocercus bonapartei (Pan.)	1 ♀, 455; 1 ♂, 500	2	0.21, 0.23
LOONS			
Gavia immer (Maine)	1 ♀, 2544; *1 ♂, 4880	2	1.10, 1.33
GREBES			
Poliocephalus dominicus (Pan.)	*6 ♀, 113.3±3.9; 8 ♂, 129.8±4.6	8	1.09±0.06
Podilymbus podiceps (Fla.)	2 ♀, 312, 375; 2 ♂, 375, 500	1	1.18
PELICANS			
Pelecanus occidentalis (Fla.)	*42 ♀, 3148±41.5; 53 ♂, 3636±42.5	12	0.815±0.022
	76 (young, 1100–3600	76	0.816±0.008
CORMORANTS			
Phalacrocorax auritus (Fla.)	*36 ♀, 1541±1.1; 30 ♂, 1810±5.4	7	0.893±0.039
	41 (young), 675–1500	41	0.824±0.017
Phalacrocorax olivaceus (Pan.)	1 ♀, 1000; 4 ♂, 1100, 1180, 1320, 1500	2	0.67, 0.72
SNAKEBIRDS			
Anhinga anhinga (Fla.)	6 ♀, 1257±41.2; *6 ♂, 1249.5±58	8	1.018±0.035
HERONS			
Ardea herodias herodias (Ohio)	1 ♀, 2040	1	1.00
Ardea herodias wardi (Fla.)	*4 ♀, 2213, 2300, 2385, 2950; 7 ♂, 2646±134	8	0.88±0.03
Casmerodius albus (Pan.)	2 ♀, 825, 952; 9 ♂, 937.4±36	5	0.82±0.04
Hydranassa tricolor (Fla.)	2 ♀, 325, 360; 18 ♂, 444±10.2	13	0.99±0.04
Florida caerulea (Fla.)	8 ♀, 315±10.4; 11 ♂, 364±14.2	3	0.67, 0.68, 0.69
Butorides virescens (Fla.)	11 ♀, 215.2±5.0; 7 ♂, 212.0±7.4	11	0.94±0.02
Agamia agami (Pan.)	1 ♀, 475; 2 ♂, 525, 550	1	0.72
Nycticorax nycticorax (Fla.)	4 ♀, 675, 795, 800, 850; 6 ♂, 810±34	6	0.90±0.05
Nyctanassa violacea (Fla.)	7 ♀, 649±16.3; 8 ♂, 716±18.3	13	0.86±0.037
Tigrisoma lineatum (Pan.)	1 ♂, 930	1	0.73
Heterocnus cabanisi (Pan.)	1 ♂, 1025	1	0.75
Ixobrychus exilis (Ohio)	3 ♀, 73, 80, 95; 8 ♂, 78.2±5.25	2	0.81, 0.85
STORKS			
Mycteria americana (Fla.)	*4 ♂, 3050, 3150, 3220, 3300	4	0.79, 0.95, 0.97, 1.01
IBISES			
Guara alba (Fla.)	9 ♀, 715±24.3; *10 ♂, 952±27.9	13	1.12±0.03
DUCKS			
Cairina moschata (domestic)	*9 ♂, 4026±241	9	0.95±0.05
Anas fulvigula (Fla.)	1 ♀, 880; 2 ♂, 1100, 1122	2	0.89, 1.00
Aythya affinis (Fla.)	2 ♀, 500, 511; 5 ♂, 601±39.5	4	0.82, 0.82, 0.88, 0.92
Nomonyx dominicus (Pan.)	1 ♀, 360; 1 ♂, 410	2	1.24, 1.36
VULTURES			
Sarcorhamphus papa (Pan.)	2 ♂, 3100, 3350	2	0.77, 0.84
Coragyps atratus (Fla.)	*6 ♀, 2172±48; 6 ♂, 1989±32.4	6	0.90±0.05
Coragyps atratus (Pan.)	1 ♀, 2000; 2 ♂, 1400, 1675	3	0.64, 0.73, 0.86
Cathartes aura (Fla.)	4 ♀, 1662±118; 10 ♂, 1479±60	12	0.71±0.03
Cathartes aura (Pan.)	2 ♀, 1275, 1800; 3 ♂, 1140, 1175, 1175	5	0.67±0.04
HAWKS			
Buteo jamaicensis (Pan.)	1 ♀, 1100	1	0.55
Buteo lineatus (Fla.)	8 ♀, 638±35.5; 5 ♂, 522±38.7	7	0.73±0.05
Buteo platypterus (Pan.)	3 ♀, 365, 398, 398; 7 ♂, 324±17.7	2	0.57, 0.61

	Body weights in grams	Number of heart weights	Hearts as per cent of body weight
Hypomorphnus urubitinga (Pan.)	1 ♀, 1250	1	0.50
Haliaeetus leucocephalus (Fla.)	*2 ♀, 3630, 3812	2	0.76, 0.84
FALCONS			
Micrastur ruficollis (Pan.)	*1 ♀, 170; 1 ♂, 165	2	0.57, 0.59
Polyborus cheriway (Pan.)	5 ♀, 930±18; 8 ♂, 882±55	1	0.90
Falco columbarius (Fla.)	1 ♀, 185	1	1.66
Falco sparverius (Fla.)	5 ♀, 114.7±6.6	1	1.27
CURASSOWS AND GUANS			
Chamaepetes unicolor (Pan.)	4 ♀, 1150, 1205, 1226, 1325; *5 ♂, 1095±63	5	0.49±0.02
QUAILS			
Colinus virginianus (Fla.)	1 ♀, 150; *5 ♂, 142±4.8	6	0.39±0.02
Odontophorus guttatus (Pan.)	3 ♀, 250, 280, 280; 6 ♂, 312±8.4	2	0.345, 0.375
TURKEYS			
Meleagris gallopavo (Fla.)	*2 ♀, 2900, 3000	2	0.39, 0.40
CRANES			
Grus canadensis (Fla.)	*1 ♀, 4110; 1 ♂, 5375	2	0.70, 0.86
LIMPKINS			
Aramus scolopaceus (Fla.)	*2 ♀, 851, 890; 2 ♂, 1000, 1225	4	0.65, 0.65, 0.76, 0.82
RAILS, GALLINULES, COOTS			
Aramides cajanea (Pan.)	*5 ♀, 355±32.8; 2 ♂, 350, 420	3	0.50, 0.51, 0.61
Laterallus albigularis (Pan.)	1 ♀, 44; 1 ♂, 58.5	2	0.57, 0.64
Gallinula chloropus (Fla.)	2 ♀, 275, 300; 4 ♂, 275, 275, 300, 400	1	1.07
Porphyrula martinica (Fla.)	7 ♀, 216±6.6; 5 ♂, 259.6±11.6	3	0.47, 0.57, 0.61
Fulica americana (Ohio)	7 ♀, 443±24.7; 8 ♂, 543.6±26.2	3	0.56, 0.62, 0.82
SUN GREBES			
Heliornis fulica (Pan.)	*1 ♀, 125; 1 ♂, 143	1	0.72
JACANAS			
Jacana spinosa (Pan.)	6 ♀, 107±8.6; *11 ♂, 77±0.8	8	0.82±0.01
PLOVERS			
Charadrius vociferus (Ohio)	6 ♀, 83.3±2.2; 6 ♂, 81.6±4.8	8	1.35±0.05
Charadrius wilsonia (Pan.)	*6 ♀, 87.4±2.8; 5 ♂, 89.5±3.9	11	1.27±0.03
SANDPIPERS			
Tringa flavipes (Fla.)	3 ♀, 100, 105, 136; 4 ♂, 70, 80, 85, 110	2	1.24, 1.45
Tringa melanoleuca (Fla.)	2 ♀, 186, 250; 5 ♂, 200.8±5.9	1	1.21
Actitis macularia (Fla.)	2 ♀, 38, 45	2	0.95, 1.16
Arenaria interpres (Fla.)	*8 ♀, 107±4.5; 12 ♂, 118±5.8	7	1.55±0.05
Limnodromus griseus (Fla.)	3 ♀, 105, 105, 110; 6 ♂, 98±2.3	7	1.53±0.07
Capella gallinago (Fla.)	1 ♀, 100; 1 ♂, 88	2	1.33, 1.34
Erolia minutilla (Fla.)	2 ♂, 18.5, 20.2	2	1.34, 1.46
Erolia melanotos (Fla.)	1 ♂, 74	1	1.70
STILTS AND AVOCETS			
Himantopus himantopus (Fla.)	4 ♀, 155±7.4; *7 ♂, 169±2.5	10	1.27±0.04
GULLS AND TERNS			
Larus atricilla	8 ♀, 306±24.4; 19 ♂, 294±5.7	3	0.73, 0.93, 0.98
Gelochelidon nilotica (Fla.)	1 ♂, 150	1	0.94
Chlidonias nigra (Fla.)	3 ♂, 54, 55, 55	2	1.16, 1.20
Sterna hirundo (Fla.)	5 ♀, 102±2.2; 7 ♂, 108±3.6	10	1.04±0.05
Sterna forsteri (Fla.)	3 ♀, 115, 120, 123; 1 ♂, 128	1	1.22
Sterna dougallii (Fla.)	7 ♀, 106.7±1.9; *4 ♂, 100, 110, 110, 112	4	1.34±0.04
Thalasseus maximus (Fla.)	9 ♀, 451±19.7; 6 ♂, 440±11.3	6	1.13±0.09

	Body weights in grams	Number of heart weights	Hearts as per cent of body weight
PIGEONS AND DOVES			
Columba albilinea (Pan.)	2 ♀, 300, 300; 5 ♂, 304±12.6	7	1.09±0.04
Zenaidura macroura (Ohio)	6 ♀, 109±1.0; 4 ♂, 131±6.3	3	1.11, 1.15, 1.37
Columbigallina passerini (Fla.)	1 ♀, 38.0; 1 ♂, 39.8	2	1.22, 1.22
Leptotila verreauxi (Pan.)	10 ♀, 149.3±4; 10 ♂, 156.3±4.6	5	0.88±0.02
Leptotila cassini (Pan.)	1 ♀, 155; 1 ♂, 175	2	0.54, 0.59
Oreopelia chiriquensis (Pan.)	3 ♀, 300, 305, 325; 5 ♂, 273±24	3	0.33, 0.42, 0.42
PARROTS			
Pyrrhura hoffmanni (Pan.)	14 ♀, 80.8±0.5; *10 ♂, 82.7±1.3	7	1.48±0.01
Brotogeris jugularis (Pan.)	3 ♀, 62.8, 64, 71; 7 ♂, 60.4±2.3	4	1.18, 1.26, 1.50, 1.53
Pionus senilis (Pan.)	1 ♀, 212; 2 ♂, 210, 220	1	1.12
Amazona autumnalis (Pan.)	2 ♀, 370, 390; 1 ♂, 425	1	1.16
CUCKOOS			
Coccyzus americanus (Ohio)	2 ♀, 56.69; 3 ♂, 44, 62, 63	4	1.0, 1.08, 1.17, 1.24
Piaya cayana (Pan.)	8 ♀, 111±2.3; 8 ♂, 104.6±3.2	9	0.61±0.02
Crotophaga major (Pan.)	3 ♀, 132, 140, 141; 5 ♂, 151.4±5.6	4	0.62, 0.66, 0.71, 0.80
Crotophaga ani (Pan.)	9 ♀, 87.7±3.4; *13 ♂, 102±2.1	11	0.57±0.03
Tapera naevia (Pan.)	1 ♀, 35.5; 5 ♂, 55±1.1	2	0.72, 0.80
OWLS			
Otus choliba (Pan.)	1 ♀, 180	1	0.52
Bubo virginianus (Ohio)	1 ♀, 1248; 1 ♂, 1040	2	0.46, 0.51
Pulsatrix perspicillata (Pan.)	*1 ♂, 800	1	0.34
Speotyto cunicularia (Fla.)	4 ♀, 130, 150, 157, 170; 4 ♂, 130, 150, 170, 170	6	0.89±0.01
Strix varia (Ohio)	2 ♀, 681, 771; 1 ♂, 642	1	0.53
Strix varia (Fla.)	1 ♀, 875; 3 ♂, 681, 750, 800	3	0.60, 0.61, 0.68
Rhinoptynx clamator	2 ♀, 400, 475; 2 ♂, young 305, 335	1	0.39
		2	0.42, 0.44 (young)
POTOOS			
Nyctibius griseus (Pan.)	3 ♀, 180, 183, 187; 3 ♂, 150, 167, 190	5	0.58±0.08
GOATSUCKERS			
Nyctidromus albicollis (Pan.)	6 ♀, 49.4±0.8; *9 ♂, 52.5±2.1	6	0.73±0.06
HUMMINGBIRDS			
Campylopterus hemileucurus (Pan.)	3 ♂, 11.2, 11.3, 13.3	3	1.87, 1.96, 2.01
Selasphorus scintilla (Pan.)	*9 ♀, 2.23±0.07; 3 ♂, 2.1, 2.15, 2.75	11	2.40±0.12
TROGONS			
Pharomachrus mocino (Pan.)	3 ♀, 170, 186, 210; 3 ♂, 188, 190, 200	4	1.32±0.06
Trogon massena (Pan.)	4 ♀, 127, 128, 130, 140; 5 ♂, 137±7.6	4	1.07±0.09
Trogon collaris (Pan.)	6 ♀, 65±2; 13 ♂, 66±1.3	12	1.02±0.03
Trogon violaceus (Pan.)	1 ♀, 69.8; 3 ♂, 56.3, 61.3, 68	2	1.00, 1.10
KINGFISHERS			
Megaceryle alcyon (Ohio)	*8 ♀, 146±3.7; 9 ♂, 191±3.3	11	1.39±0.04
Chloroceryle americana (Pan.)	3 ♂, 36.1, 36.8, 38.7	1	1.25
Chloroceryle aenea (Pan.)	1 ♀, 15.1	1	1.32
PUFFBIRDS			
Notharchus macrorhynchos (Pan.)	1 ♀, 80; *3 ♂, 89, 96, 103	1	0.56
TOUCANS			
Aulacorhynchus prasinus (Pan.)	*9 ♀, 145.4±5.5; 6 ♂, 153.7±6.1	10	0.65±0.03
Pteroglossus torquatus (Pan.)	8 ♀, 256.6±5.4; 11 ♂, 262±9.4	7	0.74±0.02
Ramphastos swainsonii (Pan.)	4 ♀, 600±10.6; 1 ♂, 680	2	0.68, 0.70

	Body weights in grams	Number of heart weights	Hearts as per cent of body weight
WOODPECKERS			
Colaptes auratus (Fla.)	4♀, 92, 95, 99, 120; 2♂, 108, 120	6	1.22±0.08
Dryocopus pileatus abieticola (Maine)	3♀, 239, 260, 289	2	1.15, 1.24
Dryocopus pileatus floridanus (Fla.)	1♂, 250	1	0.98
Dryocopus lineatus (Pan.)	2♀, 187, 200; 2♂, 165, 167	1	1.18
Melanerpes formicivorus (Pan.)	3♀, 74.5, 75, 78.2; 4♂, 69, 77, 78, 80	3	0.92, 1.11, 1.22
Centurus carolinus (Ohio)	10♀, 61.4±1.7; 9♂, 76±2.4	9	1.20±0.05
Centurus rubricapillus (Pan.)	8♀, 48.7±0.8; 17♂, 55±0.7	8	1.21±0.02
Sphyrapicus varius (Ohio)	3♀, 45, 47, 48; 14♀, 41±1.1	4	1.42±0.04
Dendrocopos villosus (Maine)	12♀, 63±1.4; 11♂, 73±1.1	9	1.23±0.03
Dendrocopos pubescens (Ohio)	19♀, 28±0.05; 23♂, 26±0.04	3	1.33, 1.34, 1.44
Dendrocopos borealis (Fla.)	4♀, 45.3±3.5; 5♂, 42.4±3.2	8	1.27±0.05
Phloeoceastes guatamalensis (Pan.)	6♀, 233.3±4.9; 3♂, 222, 255, 260	2	0.97, 1.00
WOODHEWERS			
Xiphorhynchus erythropygius (Pan.)	5♀, 45.5±1.0; 1♂, 47	2	0.87, 0.96
Xiphorhynchus nanus (Pan.)	3♀, 44, 45, 46; 3♂, 46, 49, 49	3	0.70, 0.81, 0.82
Lepidocolaptes affinis (Pan.)	3♀, 33.2, 33.5, 33.6; 3♂, 33.5, 35.5, 38	6	0.92±0.05
Sittasomus griseicapillus (Pan.)	3♀, 12.2, 12.5, 13.0; 6♂, 14.2±0.25	2	1.24, 1.43
Dendrocincla homochroa (Pan.)	3♀, 35.7, 36.2, 43.5; 1♂, 49	2	1.52, 1.71
OVENBIRDS			
Synallaxis brachyura (Pan.)	1♂, 21.1	1	1.02
Margarornis rubiginosus (Pan.)	1♂, 16.1	1	0.97
Pseudocolaptes lawrencei (Pan.)	1♀, 50.7; 1♂, 55	2	1.13, 1.22
Premnoplex brunnescens (Pan.)	2♂, 15, 15.3	2	0.97, 1.01
Anabacerthia striaticeps (Pan.)	1♀, 22; 1♂, 22.1	2	1.30, 1.34
ANTBIRDS			
Taraba major (Pan.)	*4♀, 62, 65.7, 66.7, 73.8; 1♂, 69	4	0.50, 0.52, 0.58, 0.67
Thamnophilus doliatus (Pan.)	5♀, 28.1±0.5; 7♂, 28.2±0.5	5	0.63±0.05
Dysithamnus mentalis (Pan.)	4♀, 13.9, 14.3, 14.9, 15; 5♂, 14.4±0.2	6	1.16±0.05
Myrmotherula schisticolor (Pan.)	4♀, 8.9, 9, 9, 10; 2♂, 9, 9.7	1	1.10
Cercomacra nigricans (Pan.)	2♀, 15.2, 16.2; 3♂, 16.9, 17, 17.8	4	0.68, 0.73, 0.74, 0.87
Myrmeciza longipes (Pan.)	1♀, 27.8; 4♂, 29, 29.2, 30.5, 32	2	0.57, 0.59
Gymnopithys bicolor (Pan.)	3♀, 27.8, 28.5, 29.5; 1♂, 29	2	1.03, 1.17
MANAKINS			
Manacus vitellinus (Pan.)	*7♀, 17.5±0.3; 6♂, 20.1±0.7	7	0.93±0.02
Schiffornis turdinus (Pan.)	1♀, 34.1	1	1.49
COTINGAS			
Cotinga ridgwayi (Pan.)	1♀, 60.5; 6♂, 52.8±1.8	1	1.14
Laniocera rufescens (Pan.)	2♀, 41, 52.2; 1♂, 38.6	1	1.59
Pachyramphus polychopterus (Pan.)	1♀, 20.8	1	1.15
Tityra semifasciata (Pan.)	*1♀, 73.2; 1♂, 73	2	1.16, 1.23
TYRANT FLYCATCHERS			
Sayornis phoebe (Maine)	6♀, 18.9±0.5; 6♂, 20.3±0.8	2	1.22, 1.23
Myiozetetes cayenensis (Pan.)	5♀, 25.0±1.0; 3♂, 27, 27.8, 28	4	0.79, 0.84, 0.85, 0.98
Myiarchus ferox (Pan.)	2♀, 29, 30.2; 4♂, 29.2, 31.8, 32.5, 33.7	1	0.87

	Body weights in grams	Number of heart weights	Hearts as per cent of body weight
Myiarchus tuberculifer (Pan.)	6 ♀, 19.3±0.59; 3 ♂, 19.5, 20.5, 21.0	1	0.81
Myiarchus crinitus (Ohio)	1 ♀, 33.8; 2 ♂, 34.1, 34.8	2	1.14, 1.24
Contopus virens (Ohio)	1 ♀, 15.5; 8 ♂, 14.2±0.4	1	1.53
Empidonax flaviventris (Pan.)	2 ♀, 10, 10.5; 3 ♂, 11.1, 11.2, 11.8	2	0.89, 1.30
Empidonax traillii (Ohio)	4 ♀, 11.5, 12.2, 16.5, 17.3; 6 ♂, 13.56±0.36	8	1.23±0.05
Empidonax minimus (Maine)	5 ♀, 9.22±0.68; 7 ♂, 10.1±0.25	3	1.27, 1.28, 1.52
Mitrephanes phaeocercus (Pan.)	*3 ♀, 8.0, 8.5, 8.6; 3 ♂, 9.1, 9.1, 12.5	3	1.41, 1.60, 2.00
Terenotriccus erythrurus (Pan.)	1 ♀, 8.32; 2 ♂, 16.0, 16.3	1	1.08
Platyrinchus mystaceus (Pan.)	1 ♂, 12.5	1	1.40
Todirostrum cinereum (Pan.)	8 ♀, 6.35±0.13; 5 ♂, 6.37±0.30	4	0.99, 1.00, 1.14, 1.22
Lophotriccus pileatus (Pan.)	2 ♀, 7.0, 7.2; 4 ♂, 7.5, 8.1, 8.4, 8.4	2	0.94, 0.96
Serpophaga cinerea (Pan.)	1 ♀, 7.7	1	1.38
Elaenia flavogaster (Pan.)	4 ♀, 21, 25, 25.8, 26.2; 6 ♂, 23.7±0.56	1	1.27
Pipromorpha oleaginea (Pan.)	2 ♀, 9.6, 9.8	2	1.01, 1.08
SWALLOWS			
Riparia riparia (Maine)	*4 ♀, 12.0, 15.5, 19, 20; 3 ♂, 11, 12.2, 12.8	5	1.42±0.04
Iridoprocne bicolor (Maine)	5 ♀, 22.3±2.3; 10 ♂, 22.9±0.8	4	1.42±0.03
Hirundo rustica (Maine)	6 ♀, 16.5±0.6; 1 ♂, 17.8	4	1.42±0.05
Progne subis (Maine)	6 ♀, 50.7±1.1; 16 ♂, 48.9±1.0	16	1.38±0.04
Pygochelidon cyanoleuca (Pan.)	4 ♀, 9, 9.2, 9.7, 10.1; 6 ♂, 9.8±0.03	5	1.38±0.03
Petrochelidon pyrrhonota (Maine)	4 ♀, 18.5, 19.3, 19.5, 21; 4 ♂, 17.5, 19.3, 23, 23	6	1.42±0.03
Stelgidopteryx ruficollis (Maine)	2 ♀, 13.4, 15.6; 2 ♂, 16.1, 16.2	2	1.49, 1.61
CROWS AND JAYS			
Cyanocitta cristata bromia (Maine)	4 ♀, 85, 88, 90, 98; 1 ♂, 93.6	4	0.90, 0.91, 0.95, 0.96
Cyanocitta cristata cristata (Fla.)	3 ♀, 63, 67, 75; 2 ♂, 72, 78	2	1.00, 1.15
Aphelocoma coerulescens (Fla.)	8 ♀, 70.8±1.4; 8 ♂, 73.9±1.5	13	1.07±0.03
Corvus brachyrhynchos brachyrhynchos (Ohio)	3 ♀, 400, 440, 450; – 2 ♂, 340, 445	1	1.20
Corvus brachyrhynchos pascuus (Fla).	*5 ♀, 446±5; 5 ♂, 487±7	10	0.98±0.07
TITMICE			
Parus atricapillus atricapillus (Maine)	21 ♀, 10.9±0.2; *30 ♂, 11.5±0.1	20	1.45±0.02
Parus carolinensis (Ohio)	24 ♀, 9.8±0.1; 13 ♂, 10.6±0.2	4	1.30, 1.30, 1.34, 1.45
Parus bicolor (Ohio)	12 ♀, 20.7±0.4; 17 ♂, 22.4±0.3	5	1.58±0.14
NUTHATCHES			
Sitta carolinensis (Maine)	*21 ♀, 20.8±0.2; 20 ♂, 20.9±0.2	7	1.28±0.06
Sitta canadensis (Maine)	14 ♀, 9.8±0.3; 10 ♂, 10.6±0.3	5	1.47±0.08
CREEPERS			
Certhia familiaris (Ohio)	*4 ♀, 7.3, 8, 8.5, 9.1; 11 ♂, 8.73±0.20	2	1.38, 1.71
WRENS			
Troglodytes aëdon (Ohio)	*4 ♀, 12.2±0.03; 8 ♂, 11.0±0.3	3	1.10, 1.39, 1.53
Troglodytes musculus (Pan.)	1 ♀, 14; 1 ♂, 14.8	2	1.09, 1.24

	Body weights in grams	Number of heart weights	Hearts as per cent of body weight
Thryothorus leucotis (Pan.)	3 ♀, 17.2, 18.5, 20.2; 6 ♂, 20.1±0.6	2	0.72, 0.84
Thryothorus modestus (Pan.)	2 ♀, 18, 19	2	0.84, 0.86
Henicorhina leucophrys (Pan.)	1 ♀, 16.8; 4 ♂, 16.7, 17.3, 18.1, 19	1	0.93
Telmatodytes palustris (Ohio)	1 ♀, 11; 2 ♂, 12, 12	3	1.24, 1.27, 1.43
MOCKINGBIRDS			
Mimus polyglottos (Fla.)	*9 ♀, 48±1.6; 9 ♂, 56±1.4	7	1.13±0.03
Dumetella carolinensis (Maine)	8 ♀, 38.9±1.5; 9 ♂, 37.7±1.3	5	1.09±0.05
Toxostoma rufum (Ohio)	2 ♀, 59.5, 71; 7 ♂, 72.2±1.8	3	0.87, 0.99, 1.17
THRUSHES			
Rhodinocichla rosea (Pan.)	1 ♀, 48; 3 ♂, 50, 50.5, 50.8	1	0.62
Turdus migratorius (Ohio)	6 ♀, 81.7±1.8; 12 ♂, 78.7±2.2	1	1.33
Turdus grayi (Pan.)	3 ♀, 70.5, 77, 77.5; 3 ♂, 70, 74, 77.5	3	0.77, 0.87, 1.06
Turdus plebejus (Pan.)	2 ♀, 90, 95; 3 ♂, 66, 79, 89	5	1.18±0.12
Hylocichla guttata (Maine)	*6 ♀, 30.9±2.5; 10 ♂, 31.5±0.5	12	1.21±0.04
Hylocichla fuscescens (Maine)	4 ♀, 29.5, 32.5, 33.5, 34.8; 8 ♂, 32.1±1.1	2	1.21, 1.61
Catharus griseiceps (Pan.)	3 ♀, 30.2, 30.5, 30.8	1	0.83
Sialia sialis (Ohio)	11 ♀, 31.7±0.8; 14 ♂, 30.8±0.6	11	1.21±0.04
GNATCATCHERS AND KINGLETS			
Polioptila caerulea (Ohio)	4 ♀, 5, 5.5, 5.5, 5.5; 8 ♂, 5.74±0.17	3	1.14, 1.48, 1.49
Regulus satrapa (Ohio)	12 ♀, 6.3±0.18; 10 ♂, 6.32±0.18	3	1.26, 1.27, 1.33
Regulus calendula (Maine)	*3 ♀, 5.3, 5.9, 6.3; 9 ♂, 6.6±0.3	3	1.36, 1.42, 1.78
PIPITS			
Anthus spinoletta (Ohio)	*1 ♂, 22	1	1.84
WAXWINGS			
Bombycilla cedrorum (Maine)	12 ♂, 34.25±0.74; *22 ♂, 32.77±0.66	14	1.55±0.01
SILKY FLYCATCHERS			
Ptilogonys caudatus (Pan.)	1 ♀, 33.5; *2 ♂, 38.6, 41.5	3	1.20, 1.37, 1.38
PEPPER SHRIKES			
Cyclarhis gujanensis (Pan.)	*1 ♀, 34.2; 1 ♂, 29.8	1	0.97
SHRIKES			
Lanius ludovicianius (Fla.)	5 ♀, 48.4±0.7; *8 ♂, 47.1±1.1	7	1.35±0.05
STARLINGS			
Sturnus vulgaris (Ohio)	3 ♀, 69.6, 75, 76; *3 ♂, 78.4, 79, 82.4	3	1.15, 1.30, 1.47
VIREOS			
Vireo griseus (Fla.)	1 ♀, 11.5; 8 ♂, 12.2±0.4	5	1.32±0.03
Vireo carmioli (Pan.)	1 ♀, 13.4; 2 ♂, 12.5, 13.5	3	0.97, 1.00, 1.04
Vireo solitarius (Maine)	5 ♀, 16.6±0.6; 5 ♂, 16.3±0.5	1	1.68
Vireo olivaceus (Maine)	14 ♀, 17.36±0.40; 21 ♂, 18.16±0.55	11	1.54±0.06
HONEY CREEPERS			
Dacnis cayana (Pan.)	2 ♀, 14.5, 18; *5 ♂, 12.6±0.5	1	1.50
WOOD WARBLERS			
Mniotilta varia (Maine)	11 ♀, 10.6±0.2; 14 ♂, 10.3±0.2	10	1.15±0.05

	Body weights in grams	Number of heart weights	Hearts as per cent of body weight
Vermivora peregrina (Ohio)	7 ♂, 9.78±0.59	1	1.47
Vermivora gutturalis (Pan.)	1 ♀, 9.6; 2 ♂, 9.5, 10.3	3	0.92, 1.05, 1.15
Parula pitiayumi (Pan.)	2 ♂, 6.7, 7	1	1.20
Dendroica aestiva (Ohio)	*11 ♀, 9.82±0.46; 13 ♂, 10.30±0.31	5	1.58±0.09
Dendroica magnolia (Maine)	10 ♀, 8.29±0.21; 17 ♂, 9.09±0.36	9	1.21±0.04
Dendroica caerulescens (Maine)	3 ♀, 9, 9, 9.5; 4 ♂, 9, 9.5, 9.5, 10.3	5	1.33±0.06
Dendroica coronata (Ohio)	19 ♀, 11.83±0.25; 26 ♂, 13.06±0.22	10	1.29±0.04
Dendroica virens (Maine)	16 ♀, 8.75±0.15; 20 ♂, 9.34±0.29	14	1.29±0.08
Dendroica fusca (Maine)	13 ♀, 9.63±0.17; 9 ♂, 9.35±0.30	8	1.17±0.04
Dendroica pensylvanica (Maine)	14 ♀, 9.64±0.17; 20 ♂, 9.59±0.15	11	1.17±0.06
Dendroica castanea (Maine)	7 ♀, 14.13±0.47; 15 ♂, 13.30±0.61	1	1.02
Dendroica striata (Maine)	4 ♀, 6.5, 8.3, 8.8, 11.9; 3 ♂, 13.4, 14.9, 15.2	1	1.28
Dendroica discolor (Fla.)	3 ♀, 8.7, 9, 9; 3 ♂, 7.5, 9, 9.5	6	1.24±0.05
Dendroica palmarum (Fla.)	4 ♀, 8.7, 9, 9, 10; 6 ♂, 9.25±0.42	6	1.24±0.05
Seiurus aurocapillus (Maine)	8 ♀, 19.01±0.53; 11 ♂, 18.04±0.53	12	1.23±0.03
Oporornis philadelphia (Ohio)	2 ♀, 11.5, 12; 6 ♂, 11.8±0.2	5	0.93±0.06
Geothlypis trichas brachydactyla (Maine)	12 ♀, 9.6±0.3; 22 ♂, 10.24±0.11	12	1.30±0.06
Geothlypis trichas ignota (Fla.)	2 ♀, 8.5, 9; 3 ♂, 9, 10.5, 10.5	2	1.24, 1.36
Icteria virens (Ohio)	2 ♀, 25.1, 32.5; 5 ♂, 24.6±0.5	5	1.01±0.09
Wilsonia pusilla (Pan.)	6 ♀, 7.05±0.18; 7 ♂, 7.57±0.13	5	1.05±0.03
Wilsonia canadensis (Maine)	2 ♀, 9.5, 9.8; 9 ♂, 9.94±0.23	1	1.29
Setophaga ruticilla (Maine)	12 ♀, 8.26±0.15; 12 ♂, 7.85±0.18	8	1.25±0.01
Myioborus miniatus (Pan.)	2 ♀, 8.4, 9; 5 ♂, 9.46±0.16	5	1.32±0.14
Basileuterus culcivorus (Pan.)	1 ♀, 10.1; 1 ♂, 11.3	1	1.59
Basileuterus melanogenys (Pan.)	2 ♂, 10.3, 11.2	1	0.87
TROUPIALS			
Zarhynchus wagleri (Pan.)	1 ♀, 110; 3 ♂, 200, 205, 230	1	0.99
Cacicus vitellinus (Pan.)	6 ♂, 115±3.7	2	1.06, 1.16
Amblycercus holosericeus (Pan.)	4 ♀, 55, 56, 56.7, 58; 6 ♂, 70.3±1.5	4	0.79, 0.84, 0.91, 0.96
Dolichonyx oryzivorus (Ohio)	2 ♀, 24.3, 25.1; 6 ♂, 34.5±0.8	6	1.34±0.07
Molothrus ater (Ohio)	10 ♀, 38.67±0.84; 13 ♂, 49.60±0.10	9	1.49±0.04
Sturnella magna (Fla).	9 ♀, 76.0±3.2; 20 ♂, 101.5±2.5	18	1.17±0.09
Icterus galbula (Pan.)	2 ♀, 32.5, 35.3; 8 ♂, 34.0±0.5	6	1.09±0.11
Icterus mesomelas (Pan.)	3 ♀, 52.5, 53, 50.2; 2 ♂, 57.2, 64	2	0.82, 0.87
Cassidix mexicanus (Fla.)	4 ♀, 98±3; 14 ♂, 185.8±7.7	9	1.00±0.04
Agelaius phoeniceus phoeniceus	7 ♀, 43±2.2; 9 ♂, 63±1.3	1	1.20
Agelaius phoeniceus mearnsi (Fla.)	2 ♀, 28.5, 32; 3 ♂, 46, 50, 50	4	1.09±0.10
Euphagus carolinus (Ohio)	4 ♀, 53, 55, 57.2, 58.2; 3 ♂, 65, 66, 76	3	1.18, 1.30, 1.30
Quiscalus quiscula (Fla.)	1 ♀, 77; 2 ♂, 95, 110	3	1.13, 1.13, 1.25
TANAGERS			
Chlorophonia callophrys (Pan.)	1 ♂, 24.1	1	1.37
Tanagra luteicapilla (Pan.)	4 ♂, 11.4, 12.3, 12.7, 14.5	1	1.23
Tangara larvata (Pan.)	1 ♂, 18	1	1.05
Tangara icterocephala (Pan.)	*9 ♀, 22.1±0.4; 14 ♂, 21.7±0.3	10	1.11±0.06

	Body weights in grams	Number of heart weights	Hearts as per cent of body weight
Thraupis episcopus (Pan.)	4 ♀, 33.3±1.1; 7 ♂, 32.9±0.6	3	1.13, 1.32, 1.41
Thraupis palmarum (Pan.)	4 ♀, 37.1, 40, 41.9, 45	1	0.78
Ramphocelus passerinii (Pan.)	3 ♀, 27, 31.9, 33.1; 4 ♂, 30.3, 30.5, 35, 35.4	3	0.80, 0.80, 0.92
Ramphocelus dimidiatus (Pan.)	6 ♂, 29.4±0.9	2	0.64, 0.94
Ramphocelus icteronotus (Pan.)	2 ♀, 33.7, 34	1	0.69
Piranga leucopterus (Pan.)	1 ♀, 37; 2 ♂, 32.4, 32.8	3	0.87, 0.90, 1.04
Habia rubica (Pan.)	1 ♂, 37.3	1	1.45
Tachyphonus rufus (Pan.)	4 ♀, 33.4, 35, 36.5, 37.8; 1 ♂, 31.4	1	0.65
Chlorospingus ophthalmicus (Pan.)	1 ♂, 19.8	1	0.89
Chlorospingus pileatus (Pan.)	1 ♀, 18.2	1	0.66
Phoenicothraupis fuscicauda (Pan.)	1 ♀, 34.7; 3 ♂, 36.8, 39.6, 43	4	0.71, 0.71, 0.74, 1.11
FINCHES			
Saltator atriceps (Pan.)	1 ♂, 77.8	1	1.21
Saltator maximus (Pan.)	5 ♀, 49.5±1.6; 4 ♂, 43.8, 44.8, 44.8, 47.5	2	1.28, 1.30
Saltator striaticeps (Pan.)	4 ♀, 38.3, 39.2, 41, 44.2	3	0.69, 0.75, 0.79
Richmondena cardinalis cardinalis (Ohio)	13 ♀, 42.7±0.7; 16 ♂, 45.7±0.7	6	1.34±0.09
Richmondena cardinalis floridana (Fla.)	1 ♀, 32; 4 ♂, 36, 36.9, 37, 41.2	5	0.92±0.06
Pheucticus ludovicianus (Maine)	2 ♀, 44.3, 45.6; 4 ♂, 41, 42.7, 43, 46.1	1	1.01
Pheucticus tibialis (Pan.)	6 ♀, 61.1±0.8; 3 ♂, 61.3, 63, 66	2	1.05, 1.08
Passerina cyanea (Ohio)	1 ♀, 14; 5 ♂, 15.87±0.62	5	1.44±0.07
Sporophila aurita (Pan.)	7 ♂, 10.6±0.2	2	1.0, 1.2
Tiaris olivacea (Pan.)	4 ♀, 8.5, 9, 9.3, 9.8; 4 ♂, 8.5, 8.6, 9, 10	2	0.97, 1.02
Atlapetes brunnei-nucha (Pan.)	2 ♀, 35.3, 37; 3 ♂, 40, 41, 44.2	2	0.77, 0.97
Atlapetes gutturalis (Pan.)	1 ♀, 35; 2 ♂, 33, 39.2	1	1.11
Pselliophorus tibialis (Pan.)	2 ♂, 32, 33.1	2	0.86, 0.88
Arremonops striaticeps (Pan.)	9 ♀, 37.1±0.7; 5 ♂, 41.9±0.6	5	0.91±0.02
Arremonops conirostris (Pan.)	1 ♂, 41.8	1	0.76
Pipilo erythrophthalmus erythrophthalmus (Ohio)	2 ♀, 36.9, 39; 16 ♂, 42±0.5	3	1.24±0.14
Pipilo erythrophthalmus alleni (Fla.)	4 ♀, 36.3±0.5; 11 ♂, 44.1±0.7	13	0.84±0.03
Passerculus sandwichensis (Ohio)	5 ♀, 13.4±0.8; 5 ♂, 18.4±0.6	5	1.46±0.12
Ammodramus savannarum (Ohio)	1 ♀, 16; 3 ♂, 15.7, 17, 17	4	1.35±0.08
Passerherbulus henslowii (Ohio)	2 ♂, 11.3, 12	2	1.35, 1.37
Spizella passerina (Ohio)	2 ♀, 14, 18.1; 2 ♂, 12, 16.2	4	1.03, 1.17, 1.18, 1.32
Spizella pusilla (Ohio)	3 ♀, 12.2, 12.8, 14.2; 7 ♂, 15±0.9	8	1.29±0.04
Zonotrichia albicollis (Maine)	9 ♀, 25.4±0.7; 9 ♂, 29.6±1.0	1	1.00
Zonotrichia capensis (Pan.)	4 ♀, 20.2±0.8; 7 ♂, 21.0±0.2	6	0.84±0.04
Melospiza georgiana (Maine)	10 ♀, 15.38±0.71; 18 ♂, 18.53±0.45	6	1.19±0.06
Melospiza melodia (Ohio)	11 ♀, 19.89±0.54; 21 ♂, 22.11±0.45	7	1.18±0.05

DISCUSSION

One of the earlier publications on the subject of heart weights is that of Parrot (1893) who lists 97 species represented by 181 specimens. Generally speaking his shorebirds had larger hearts than did our shorebirds. Likewise we differed in many other groups. Hesse (1921) and Rensch (1948) included birds in their study of vertebrate hearts, and Groebbels (1932) compiled a summary of data from other authors. Groebbels found that the data for the same species given by different authors were often contradictory. He attributed this to differences in the method of preparing the heart. He also noted that in some species the heart size differed between the sexes. We have not found such differences in this study.

Sakharova (1946) determined the heart weights in 250 individual birds from the Moscow Zoological Park and compared them with data in the literature. She reported that in some a small difference could be observed which was most often expressed in an increase in the cardiac index of the birds from the Zoological Park. She suggests that this was due to the emaciation resulting from sickness. Therefore those values can hardly be taken as typical. However, in most cases her values agreed with those in the literature which she cites. She notes further that very little change occurs in the cardiac index in birds kept in cages for a long period and that the size of the heart is a more or less constant characteristic for the species.

Crile and Quiring (1940) published heart weights of more than 50 species of birds from North America and Africa, many of them being represented by only one or two individuals. We have values for 14 of the species which they report. If one allows for individual variation, we are in fair agreement except for the Turkey Vulture (their heart value is 2.07 per cent compared with ours of 0.71 per cent), the Great Horned Owl (their value, 0.73 per cent; ours, 0.49 per cent) and the Brown Pelican (their value, 0.66 per cent; ours, 0.815 per cent). Their Turkey Vulture must have been a young bird since it weighed less than one-third as much as an adult.

Stresemann (1927:203) has pointed out that large birds have comparatively smaller hearts than do smaller birds whereas Parrot (1893), Groebbels (1932), Stresemann, and Rensch concluded that birds flying great distances or living in northern latitudes or high altitudes possessed relatively larger hearts than did other birds.

Although size appears to be a factor in the relative proportion of the heart, other influences modify this relationship. Some of these have been indicated but there are differences which are unexplained. For example, the Roseate and Common terns are alike in size but the former possesses the larger heart. On the other hand, species in which the sexes differ in size have hearts which are alike in percentage.

Why do the heart values tend to follow one straight line until about 200 grams body weight and then show slight relative decrease? This question is unanswered. Could it be due to an abrupt change in metabolism? The relative size of the heart must be associated with the rate of metabolism. The latter is raised with increased heat loss and with exercise. Small birds produce more heat to compensate for heat loss through their relatively large surface area and they are more active than large birds. The differences among birds of nearly the same size may be due to differences in activity. Certainly this is true in some species.

Let us examine the data which support this thesis. First of all, the trochilids are probably the most active birds and have, relatively, by far the largest hearts (Hartman, 1954). Many other small birds are very active and have relatively large hearts. The Chat, which is the largest of the parulids, is less active than the smaller members of the family and has apparently the smallest heart. The larger members of the fringillids

possess smaller hearts in proportion to their size and may show less activity. The larger icterids have smaller hearts than the smaller members of the family and may be less active (for example, *Cassidix* and *Sturnella*).

Among the shorebirds, those with relatively larger hearts may be the more active, but the difference in this respect is difficult to evaluate. *Arenaria* and *Limnodromus* possess larger hearts than do others. Birds such as tinamous, quail, and turkeys that rarely fly long distances have very small hearts. Vultures that soar most of the time have smaller hearts than those which flap their wings frequently.

Estimation of the relative amount of physical activity by observation of the birds in the field can be but a crude approximation. A chattering bird or a vigorous songster does not necessarily engage in great muscular exertion. Exact comparison could be made only by measurement.

These limited observations suggest that activity may be a determining factor in heart size in birds. There is evidence that this is true in mammals. Steinhaus, Kirmiz, and Lauritsen (1932) showed that swimming or running caused cardiac hypertrophy in the dog, the former being more effective than the latter. McClintock, Hines, and Jordan (1939) observed that voluntary activity in the female rat in revolving cages for six and one-half months increased dried heart-weight by 10 per cent. Wild hogs possessed hearts 0.638 per cent of the body weight; in domestic hogs they were only 0.38 per cent of the body weight (Geschwend, 1931).

We have calculated the heart weight in terms of per cent of body weight in data published by Crile and Quiring (1940). The greyhound had relatively one of the largest hearts, at 1.26 per cent, and the collie-police dog had a heart only 0.77 per cent of the body weight. Almost all values for mammals were lower than a vast majority of those for birds. Here again, heart-size often was related to activity. The following examples illustrate: grizzly bear, *Ursus horribilis* (zoo specimen)—0.79 per cent; jaguar, *Felis onca* (from zoo)—0.54 per cent; tiger, *Felis tigris* (captive)—0.33 per cent; porpoise, *Phocaena phocaena*—0.52 per cent; anteater, *Tamandua tetradactyla*—0.44 per cent; three-toed sloth, *Bradypus griseus*—0.24 per cent; monkey, *Macacus rhesus*—0.33 per cent; squirrel, *Sciurus hudsonicus*—0.73 per cent; and meadow mouse, *Microtus drummondi*—0.70 per cent. Thus we see that on the whole, mammalian hearts are smaller than avian hearts. This had been shown to be true by Parrot (1893).

Why does climate affect heart size, if it does? Granted that our data are too meager to bear conclusively on this point, they do suggest such an effect. A comparison of subspecies should be most valid (for example, *Richmondena cardinalis cardinalis* and *R. c. floridana*). The northern subspecies has a greater range of stimulation, longer daylight in summer and shorter in winter, together with a greater range in temperature and correspondingly the heart is larger. In the areas corresponding to these races, the mean annual temperature is 54.4°F. (Ohio) and 71.9°F. (Florida).

Does season affect heart size? Our data derived from just a few species are only suggestive. If the difference is valid, it might be explained by difference in activity. In the short daylight of winter in northern climates, birds seek their food, bask briefly in the sun, if at all, and hunt some spot where they can be undisturbed for the long night. This is in contrast to the long summer daylight with prolonged activities of courting, feeding of young, and general reaction to environment.

We have very little data on the effect of altitude, the Quetzal being our sole example. In the tropics the essential difference between low and high altitudes is temperature, especially the cold nights of the latter, the length of daylight being the same. Strohl's observations (1910) on *Lagopus* bear on this point. He found that the hearts of *L. mutus,*

the alpine ptarmigan were relatively much larger than the hearts of *L. lagopus*, the marsh ptarmigan. He attributed this to the differences in altitude to which the birds were subjected.

When does the heart of the developing young bird reach the same proportion to the body as that in the adult? Laura Kaufman (quoted by Groebbels, 1932) has reported the relative heart weight in the domestic pigeon at different ages. From the seventh through the thirteenth day it is much larger (1.8 to 1.6 per cent) than in the adult (1.3 per cent). The time at which the heart percentage becomes the same as in the adult may vary in different species, but more evidence in support of this idea is needed.

In general, it may be said that the smaller, more active birds have relatively larger hearts. In other words the larger hearts are associated with increased metabolism necessitated by heat loss or caused by exercise. Differences between sexes as to heart weight are rare or absent. The inaction brought on by long winter nights is associated in some species with smaller heart weights. Also warm climates may be associated with relatively small hearts. Undoubtedly many factors are involved. A characteristic heart size is inherited. This must be modified by natural selection acting on variations through many generations in response to the circulatory requirements arising from conditions imposed by exercise, heat production and the environment. The heart of each individual may be modified temporarily by any of these influences, but the heart of the average member of the species represents the total response over many generations.

SUMMARY

Percentage heart weights for more than 1340 birds distributed among 291 species and 64 families, are given. These specimens were collected in the eastern United States and Panamá.

When the logarithms of the heart weights are plotted against those of the body weight the values tend to follow a straight line to about 200 grams body weight and then follow another line that is slightly steeper.

Percentage heart weights range from a little more than 0.2 per cent in tinamous to 2.4 per cent in hummingbirds. Relatively small hearts are also found in *Colinus*, *Meleagris*, and *Chamaepetes*. Somewhat larger are those of some hawks, some rails, some cuckoos, and many owls. Relatively large hearts are found among shorebirds, kingfishers, swallows, titmice, nuthatches, creepers, waxwings, vireos, and warblers.

No evidence of a difference in heart size was found between the sexes.

The age at which heart size attains adult magnitude appears to differ among species.

Heart size is related to activity in many instances, those of birds accustomed to sustained strenuous exertion being the largest in proportion to the body.

Limited data on several species suggest that heart weight decreases in the colder months of the year in some species.

Certain northern subspecies appear to have larger hearts proportionately than do southern subspecies of the same species.

Larger hearts may be associated with permanent residence at high altitude.

Heart weight in birds is relatively greater than in mammals.

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FROM FIELD AND STUDY

Snowy Plover (*Charadrius nivosus*) and eggs at Huntington Beach, Orange County, California, June 27, 1953. Photograph by Ray Quigley, Jr.

Territorial Behavior in Fall Migrant Rufous Hummingbirds.—In most species of North American hummingbirds, male territoriality centers on a feeding ground (Pitelka, Condor, 44, 1942: 189–204). To my knowledge little has been recorded on this activity in the Rufous Hummingbird (*Selasphorus rufus*). From August 20 to 24, 1954, a group of six hummingbirds was observed in territorial behavior at a feeding ground in the Old Faithful area of Yellowstone National Park, Wyoming. Five of the birds were migrant Rufous Hummingbirds with terminal white spots on the three outer retrices and red throat patches of one or two feathers. From this it was presumed that the birds were immature males [adult females appear the same and might have been involved in part—Editor]. The sixth bird was much smaller, lacked the throat patch and had no trace of rufous. It was decided that this bird was a Calliope Hummingbird (*Stellula calliope*).

The feeding area consisted of an irregular patch of *Linaria vulgaris* which extended for about fifty feet in a northeast-southwest line and varied from six to twenty feet in width. Five territories were already established when the birds were first observed. Each territory extended about six to eight feet along the northeast-southwest line and included the full width of the plant zone at that place.

The territories were contiguous and all well defined except the territory at the southwest end. Often two or more birds fed there at one time. The home bird would occasionally defend the area, but often this bird was more likely to ignore intruders and even try to feed in other territories. The sixth bird, the Calliope Hummingbird, did not have any territory but would feed wherever it could.

Perches were on grass stalks, on telephone wires overhead, or on the ground, usually on a slight rise. The birds generally selected the same perch, although each bird also had one or two additional perches which were occasionally used. One bird had a subsidiary perch in a lodgepole pine tree eighty-five feet distant. Several times this bird dashed directly to its territory to chase an intruder which had entered. Never were there perches on *L. vulgaris*. Although the birds were in full view of each other, chases never occurred except when one bird entered the territory of another.

The sixth bird often started a chain reaction of chases. It would enter a territory and feed until sighted by the occupant. The chase started with the occupant diving at the intruder with the tail full spread. The chase often led through adjoining territories with each occupant in turn defending its territory by joining the chase and with a general melee resulting. Squeaking often accompanied the chase. The chase might last for only twenty feet or might cover several hundred feet. Often when a chase passed over an adjoining territory, the occupant would rise above the territory, squeaking and with tail full spread. After a bit of darting approximately a foot in several directions, it would settle back down. Feeding or apparent feeding took place after a chase.

There were some areas on the perimeter of the plant zone, especially at its greatest width, and between two territories which were not clearly in either territory. Either bird might chase the other one out of this zone. The bird which was feeding was the one chased. These chases were of short duration and usually involved only display and squeaking. During display the birds faced each other with tails spread fan-wise, exposing the rich rust tail feathers, and rocked back and forth. These arcs were about four to six inches in amplitude. When the display was more violent, the rocking was followed by back-and-forth dashes. These dashes were more common when a home bird and an intruder inside a territory squared off at each other and the dashes often preceded the chase. The hovering display might last for several seconds before each bird returned to its territory. One bird sometimes would pursue the other; then both would back off and display.

The bird from the southwest territory also entered the other territories for feeding, but the remaining birds were never observed to do this. Several times it was possible to single out one bird and follow it through a succession of chases during a general melee, after which the bird always returned to its original territory.

During the chases the red throat feathers could often be seen flashing. It could not be determined if these flashes were solely the result of the sun striking the red throat feathers or if the birds ruffed up the throat feathers during a chase. One bird was studied closely on a perch and the impression was gained that the bird did ruff up the throat feathers as a type of display.

Bees and dragonflies were occasionally chased by the hummers and often these insects in turn chased the birds, but usually they ignored one another. Observations were discontinued after the fifth day because the birds left as quickly as they came.—KENNETH B. ARMITAGE, *University of Wisconsin, Green Bay, Wisconsin, January 21, 1955.*

Black Skimmer in North-central Texas.—In view of the paucity of inland records of the Black Skimmer (*Rynchops nigra*), it seems worthwhile to report the recent occurrence of this bird at Mountain Creek Lake in western Dallas County, Texas. On August 6, 1954, Lt. Jane O'Regan of Boston, Massachusetts, called the museum to report that while watching birds at the lake on the previous day she had found a Black Skimmer in immature plumage in association with a flock of fifty or more Black Terns (*Chlidonias nigra*). Her report was of such interest that on that same afternoon in company with H. P. Kirby I visited the lake. Following Lt. O'Regan's directions to the part of the lake where she had made her observations on the previous day, we quickly located both the flock of terns and the skimmer which still remained in their company. The bird was not collected. Mountain Creek Lake and Dallas County are both in north-central Texas and approximately 300 miles north of the nearest point on the Gulf coast.—F. W. MILLER, *Dallas Museum of Natural History, Dallas, Texas, February 25, 1955.*

The Responses of Salt-marsh Birds to Extremely High Tides.—The highest high tides occur when the sun and moon are in conjunction. There are two periods each year during which this condition is approached or attained on the Pacific Coast of North America. One of these periods is in June and July, the other from November to January. At these times the tidal level at the Golden Gate of San Francisco Bay, California, may be as much as +7.0 feet. Due to the funnel effect of the tapering southern arm of San Francisco Bay the tidal level at Alviso, Santa Clara County, is approximately 2.6 feet higher than at the Golden Gate.

The highest high tides of June and July occurred during the night in 1949 and 1950, and no observations were made, but the winter high highs in these years reached their maximal points during daylight. On November 19, 1949, the highest level was +6.7 feet at the Golden Gate and +9.3 feet at Alviso at 11:56 a.m. (Tide Tables, Pacific Ocean, U. S. Coast and Geodetic Survey). By 11:00 a.m. the water was already high enough to have covered all the mud flats and low *Salicornia* and only the taller emergent plants such as *Spartina* were visible in the salt marsh in the vicinity of the San Jose City Dump, approximately one mile east of Alviso. The larger shorebirds, principally Willets (*Catoptrophorus semipalmatus*), were flying about and settling on any emergent object. The smaller Least (*Erolia minutilla*) and Western (*Erolia mauri*) sandpipers were perching on floating boards and competing for space on the still emergent parts of levees.

Nearly 100 small land birds, which were wintering along the dikes and roads, were concentrated on the levee along which I walked into the marsh. As I proceeded, the birds moved ahead rather than flying across the open water now covering the marshes. The flock was composed to the extent of approximately 75 per cent of Song Sparrows (*Passerella melodia*); there were a few Savannah Sparrows (*Passerculus sandwichensis*) and White-crowned Sparrows (*Zonotrichia leucophrys*), five or more Long-billed Marsh Wrens (*Telmatodytes palustris*), and one Yellow-throat (*Geothlypis trichas*). At least 10 Short-eared Owls (*Asio flammeus*) flushed in front of me as I walked a two-mile section of the levee. One, hunting along the levee, flew past at shoulder height less than three feet away.

On December 17, 1949, the highest tidal level at the Golden Gate again was +6.7 feet. The highest point reached the Alviso railroad bridge (Southern Pacific) over Coyote Creek slough at 10:43 a.m. Because of the convolutions of tidal channels in the marsh there is a lag of approximately one hour between the maximum level at the railroad bridge and that in the marshlands east of Alviso. On this date, in company with Keith L. Dixon and Robert L. Rudd, a rowboat was launched at 9:30 a.m. from the road which follows the outfall of the sewer line which empties into Coyote Creek. The incoming tide carried the boat into a section of salt marsh between Alviso and the San Jose dump. By 10:00 a.m. all mud flats were covered.

At 10:30 the first Virginia Rail (*Rallus limicola*) was collected and in the next half hour three more Virginia Rails and two Soras (*Porzana carolina*) were taken. By noon five Virginia Rails and four Soras had been collected and at least seven more Virginias and 10 Soras had been seen. One obviously tired Sora was followed in the boat as it twice flushed and flew. The third time we approached the swimming bird it dived beneath the surface and remained submerged for several seconds. It dived four more times and was timed for submerged periods of 20 and 25 seconds. After each dive it was noticeably more waterlogged and fatigued. Finally we came slowly up to it as it floated and picked it up without a struggle. When released on land an hour later, the bird walked about for several minutes, then took flight and returned to the marsh. All the rails which were clinging to the emergent stems of *Spartina* were easily visible. Several were observed swimming in the open water. Three Clapper Rails (*Rallus obsoletus*) were seen and others were heard.

On December 18, 1949, the maximum level at the Golden Gate was +6.8. The high point arrived at Alviso at 11:25 a.m. and was approximately +9.4 feet. The weather was overcast and cold with occasional rain squalls. In company with Matthew F. Vessel and Albert Wool a rowboat was launched at 10:00 a.m. and the tide carried us to the main marsh area approximately one mile east of Alviso. In the next four hours we saw approximately 10 Clapper Rails, 12 to 15 Virginia Rails and 15 to 20 Soras. One noticeably waterlogged Sora was forced to dive twice as we pursued it. The third time it dived I could see it swimming approximately six inches beneath the surface and, plunging my hand into the water, was able to catch it. It too recovered and was later released in apparent good health. On December 17 Albert Wool had captured a Virginia Rail by hand as it crouched on a levee during the high point of the tide. A Clapper Rail on the 18th was observed swimming across an area of open

water with a mouse (probably *Reithrodontomys*) in its bill. A California Gull (*Larus californicus*) dropped down and struck the rail, which released the mouse, whereupon the gull picked it up and flew off.

In one clump of *Spartina* three Virginia Rails were found huddled in contact with one another. A fourth was six feet away on some *Salicornia*. In another clump of *Spartina* we found one Clapper Rail, three Soras, and two Norway rats (*Rattus norvegicus*). Many other Norway rats were seen and several meadow mice (*Microtus californicus*) and harvest mice (*Reithrodontomys megalotis*) were observed. All these mammals swam readily. One Norway rat was picked up as it swam feebly, in obvious distress. When placed in the boat, it lay gasping and died within an hour, apparently from drowning.

The tide on December 8, 1950, reached +7.0 feet at the Golden Gate and +10.3 feet at Alviso. This tide flooded the town of Alviso, causing considerable damage. With David Nelson a rowboat was again used to observe in the marsh. In a period of two hours we saw five Clapper Rails, four Virginia Rails, and four Soras. A Virginia and a Sora were collected.

On December 9 the tide attained the same maximum as on December 8. By walking and wading out the roadway paralleling the sewer outfall the Southern Pacific tracks were reached. The water was over the tracks in some places and over the ties in most portions of the marsh crossing. Many Norway rats taking refuge on the railroad levee had been killed by trains. At least 50 dead rats were noted in a one-half mile section and 30 to 40 living ones were seen in the same distance. More than 30 *Microtus* were seen and 20 shrews (*Sorex vagrans*) were captured alive when found hiding under loose boards and rubble on a small island.

Many gulls, probably mostly California Gulls and Ring-billed Gulls (*Larus delawarensis*), were seen to drop down into the marsh. One gull was observed with a mouse in its bill. A Marsh Hawk (*Circus cyaneus*) was watched as it made a strike at an area of emergent vegetation, presumably in an attempt to capture a small mammal.

It is decidedly unusual to see either Virginia Rails or Soras in the San Francisco Bay salt marshes during periods of low or average tides when the vegetation is not submerged. From the evidence of these several days of observation during unusually high tides these species seem to be fairly common during the winter.—CHARLES G. SIBLEY, *Department of Conservation, Cornell University, Ithaca, New York, March 6, 1955.*

Early Nesting of Golden-crowned Kinglet.—Saunders (Pac. Coast Avif. No. 14, 1921:163) states that the Golden-crowned Kinglet (*Regulus satrapa*) undoubtedly breeds in Montana, as it is common all summer in the mountains, but that the nest appears not to have been found and recorded. He adds that young were seen out of the nest at Flathead Lake on July 23, 1914. On March 19, 1941, among evergreens two miles north of Libby, Montana, I heard kinglets calling from a Douglas fir, and in the same tree discovered a nest that was new, green, covered with moss, and practically complete. A male Golden-crowned Kinglet flew down from it to a branch. A moment later, a female with material in her bill flew into the semi-pendant nest. This event followed an abnormally warm winter and early spring. For some time Golden-crowns, wintering in these woods, had been trooping by themselves rather than with the chickadees and nuthatches.

On March 20 both kinglets carried material to the nest, and I noted: "It is 7 feet out on a down-sweeping branch near its tip, 25 feet up. Saw Golden-crown enter, test and turn about in it and shape interior for more than a minute, then fly down and gather moss from upper side of Douglas fir limbs. Nest tree stands in Douglas fir border grove of conifer and broadleaf woods. Just to the south are arid yellow pine flats."

On March 21 the pair of kinglets was observed at the nest. After April 8 the spot was visited infrequently. On May 2 the nest was found to have been recently destroyed.

Dawson and Bowles (Birds Wash., 1909:267) mention a nest with half-grown young on April 9 in western Washington. Bent (U. S. Nat. Mus. Bull. 196, 1949:397) quotes Rathbun in regard to the Golden-crowned Kinglet, referring to the vicinity of Seattle, Washington: "We have seen it carrying material for its nest as early as April 4; . . . the bird was gathering bits of green moss from a decayed log, which would indicate the earlier stage of construction; and we have a record of unfledged young in the nest on May 17."

The fact that the nest discovered at Libby, Montana, on March 19 was nearly complete, together with the fact that family bands containing fledglings are seen here in August, further supports the belief of Rathbun (Bent, *op. cit.*, 1949:398), and Jewett, Taylor, Shaw, and Aldrich (Birds Wash. State, 1953:530) that two broods may be raised in our northern states by this species in one season.—JOHN L. BLACKFORD, *Libby, Montana, February 23, 1955.*

Whistling Swan and Snowy Owl in Texas.—The Whistling Swan (*Cygnus columbianus*) was a common winter visitant in Texas in the past century but we have found no records of its occurrence in the state in the past fifty years. Some recent events suggest that it may be reclaiming its old winter range. In late November, 1954, three Whistling Swans were shot by hunters near Lubbock, Texas. We are indebted to game warden Morris Stallcup, of Wichita Falls, for this information. On January 3, 1955, two hunters shot a Whistling Swan on a stock tank of the Taylor Ranch in Archer County, Texas, a few miles south of Wichita Falls. The confiscated bird was deposited in the collection of the Biology Department of Midwestern University, at Wichita Falls. Two weeks later, on January 12, one of us (Lewis) saw a swan in the shallows of the Canadian River north of Amarillo, Texas.

Although four of the five Whistling Swans known to have visited Texas in the past two years were killed, it is hoped that future migrants will be treated more kindly. All individuals killing swans have been arrested and newspapers in Lubbock, Amarillo and Wichita Falls have published the occurrences of the birds and emphasized the fact that they are protected by law.

The occurrence of the Snowy Owl (*Nyctea scandiaca*) as far south as Texas is most unusual. Bent (U. S. Nat. Mus. Bull. 170, 1938:374) mentions only two: one in 1850 and the other in 1876. A recent record may therefore be worthy of note. On February 16, 1955, a biology student at Midwestern University informed us that a large, white owl had been seen that day on the shores of Lake Wichita, three miles south of Wichita Falls. The next day one of us (Dalquest) accompanied the student to the lake. The owl was found on a rocky, wave-swept beach, barren except for a few scrubby mesquite trees. It was observed at a distance of 50 feet and identified as a Snowy Owl. The following day the owl was found on a nearby point. Again it had picked a retreat of barren, wave-swept, rocky beach, which must have most closely resembled its arctic home. It proved to be a male with small testes. Its plumage was in good condition except that the feathers of the tail, save for the outermost, were eroded away until little was left but the midribs. A heavy infestation of birdlice was noted. There was a small, scabby wound on the fleshy part of one wing and another, larger, infected sore on one flank. The wounds did not seem to affect the bird's health; it was moderately fat.

The stomach of the owl was filled with the remains of a female Red-winged Blackbird (*Agelaius phoeniceus*). Three regurgitated pellets, which were picked up earlier, contained bird remains only: one a meadowlark (*Sturnella*), one a large finch and a small finch; and the other a Robin (*Turdus migratorius*).—WALTER W. DALQUEST and LEO D. LEWIS, *Texas Game and Fish Commission, Wichita Falls, Texas, March 15, 1955.*

A Recent Record of the Sharp-tailed Grouse in Nevada.—On September 14, 1952, Grover Freeman and I, while in the field as members of the Nevada Fish and Game Commission, observed a flock of twelve Sharp-tailed Grouse (*Pedioecetes phasianellus*). These grouse were found on a spur of the Capitol range in Humboldt County, Nevada, near the Humboldt-Elko County line, approximately 26 miles northeast of Golconda. Upon seeing the flock in the distance, we took them to be Sage Grouse (*Centrocercus urophasianus*). By stalking, however, we were able to come within thirty-five yards of the birds and make a certain identification. Linsdale (Condor, 53, 1951:232) quotes a letter from Ira La Rivers who reported seeing a flock of six Sharp-tailed Grouse on July 9, 1939, in north-central Elko County.—WILLIAM Q. WICK, *Washington Department of Game, Mount Vernon, Washington, April 23, 1955.*

Killdeer Decoys Duck Hawk from Young.—On May 7, 1953, a pair of Killdeers (*Charadrius vociferus*), with four young just out of the nest was observed on Eliza Island, Washington. A duck hawk (*Falco peregrinus*) flying toward nearby Lummi Island passed one of the adult Killdeers offshore approximately 300 yards in the air. The falcons returned shortly, leisurely maneuvered until directly above the Killdeer, then broke into a dive. Almost at the same instant the Killdeer went

into a dive, then veered off just as the falcon would have sped into its intended prey. The Killdeer had ample time to dive toward the island for cover but it remained flying about in the same small area.

The falcon continued to climb and dive on the Killdeer, but after eight thrusts the Killdeer hugged the water and shore so closely that it eluded the falcon, which soon left the area. This event was the first witnessed by the observer in which a prey species appeared to decoy from its young an avian predator of such superior flying power.—Wayne H. Bohl, *Tucumcari, New Mexico, April 11, 1955.*

Gambel Quail and Water Supply on Tiburón Island, Sonora, México.—As there remains a question in the minds of some as to the water requirements of the Desert or Gambel Quail (*Lophortyx gambelii*), notwithstanding the work of Vorhies (Am. Nat., 62, 1928:446–452) and of Gorsuch (Univ. Ariz. Biol. Sci. Bull., 2, 1934:41–42), the following field observations are presented as further evidence that populations of this species do not require the proximity of free surface water.

From April 22 to 24, 1954, large numbers of quail were observed by E. Tad Nichols of Tucson and myself in the desert brush along and near the beaches on the east side of Tiburón Island, Sonora, México, and several males were heard calling. Fresh spring water is scarce on the island; very small amounts can be obtained only at a few well-known points, and the Seri Indians carry it from inland to their occasional beach camps. Our field headquarters was at such a Seri camp. The nearest fresh water to the position where the quail were observed was approximately 8 miles inland by trail, or a distance of approximately 6 miles airline.

This distance is at least 10 to 11 times greater than the daily cruising range (= home range) of species of quail for which data are available (Gorsuch, *op. cit.*: 48–49). For example, the daily cruising range of the Bob-white (*Colinus virginianus*) is known to be approximately one-fourth of a mile. Even if the daily cruising range of the Gambel Quail is as much as 2 miles, which is probably as much as 3 to 4 times the actual magnitude, the distance to fresh water was still 3 times as great.

The observations were made in April during the particularly dry period which precedes the summer rainfall season. (On Tiburón Island and the adjacent mainland of Sonora, the precipitation pattern is reversed from that in California and Nevada; the wet season is the period from June to September.) There can be little question but that the Gambel Quail on Tiburón Island obtain water required for metabolic processes from the abundant succulent vegetation on the island, as this species does, for example, in southern Arizona, where and when free surface water is not available during the drier periods of the year. If the Gambel Quail on the east coast of this arid island drink water other than that which occasionally falls during the summer rainfall season, it must be sea water. It is beyond reasonable doubt that the Gambel Quail occurring on Tiburón Island do not require free surface water of any kind for their successful maintenance during the dry periods of the year. —Charles H. Lowe, Jr., *Department of Zoology, University of Arizona, Tucson, November 29, 1954.*

Taxonomic Comments on the Western Wood Pewee.—In volume 9 of the "Reports of Explorations and Surveys . . . for a Railroad . . . to the Pacific Ocean . . . ," (1858:189–190) Baird hes'tantly applied the name *Tyrannula richardsonii* Swainson (Fauna Bor.-Am., 1831:146) to a series of wood pewees from the western United States and México. But he noted that Swainson's type, from Cumberland House, Saskatchewan, "differs in the proportions of the wings, etc., . . . in some other points appearing more nearly allied to *S. fuscus* [= *Sayornis phoebe*]." Baird thought, however, that "The discrepancies in the proportions of the quills [= primaries] may have been caused by their incomplete growth during the moulting season."

The matter was again discussed by Coues (Birds Northwest, 1874:247), who first noted that Swainson's plate of *Tyrannula richardsonii* is "very wrongly colored" for a wood pewee; but he then followed Baird, stating that "the different wing formula may be reconciled upon the supposition that the type of Swainson's species was a young bird . . . ." He also noted that "The plate . . . [is] not so far out of the way for the *very* young bird, which is rusty-tinged . . . ." His conclusion was that "In view of the facts that Swainson's bird was a *Contopus,* and that the present [Western Wood Pewee] is the only one ever known to inhabit the ascribed locality, the identification may be safely made."

No one since Baird and Coues seems to have questioned the matter. Phillips, however, became

puzzled by the type locality of *richardsonii* during his study of our more difficult tyrannids. Having no access to the original description, Phillips enlisted Parkes' aid in an effort to locate and redetermine Swainson's bird. First, we inquired about the type specimen, which we learned is no longer extant.

The facts, as now known, are almost entirely at variance with Coues' statements. The type specimen was taken in June, and the plate bears little or no particular resemblance to juvenal-plumaged *Contopus*. The "rusty" or buffy-brown tinge of young Western Wood Pewees is comparatively slight, and it is most prominent on the light wing-bars, which Swainson neither mentions nor figures. Any bird young enough to have an altered wing-formula would also have an abbreviated tail. The tail-length given by Swainson (two inches, nine lines) is that of a full-grown bird, and matches *Sayornis* rather than *Contopus*. A fact which should be noted here, unknown in Baird's time, is that the wing molt occurs on the wintering grounds. A series of Western Wood Pewees from Ecuador and Peru in the American Museum of Natural History showed wing molt between the extreme dates of December 1 and March 15. An additional consideration is that pewees are late migrants and would not have young out of the nest in June in central-eastern Saskatchewan. The interpretations of Baird and Coues to the effect that the type of *richardsonii* was a young bird are thus quite impossible.

Furthermore, Coues' final summary of reasons for identifying Swainson's type as a Western Wood Pewee ("In view of the facts that Swainson's bird was a *Contopus*," etc.) is also quite erroneous. No one ever examined Swainson's type after Cabanis worked out the genera of North American Tyrannidae, if indeed it was then still extant. The status of pewees at the type locality of *richardsonii* is to this day obscure. W. Earl Godfrey, who kindly lent Phillips the western Manitoba series from the National Museum of Canada, remarks (*in litt.*) that pewees of all kinds seem to be scarce so far north. Both species appear to be represented in the Manitoba series, but the majority consists of late summer birds in such worn plumage as to make identification exceedingly difficult.

The status of the two pewees in Saskatchewan and Manitoba affords an intriguing problem, which we hope will receive careful attention. Zoogeographically, this area is wholly eastern in its affinities, so the Western Wood Pewee appears definitely out-of-place. Therefore it may be that, as in the case of the southern plains race of *Empidonax traillii*, an eastward extension of range is even now taking place. Another indication of this possibility is the absence of records of the Western Wood Pewee as a migrant in the states directly south of the Saskatchewan-Manitoba area. The problem well deserves an immediate investigation, on a continuing basis. Only by careful field studies, preferably in early June (*not* late July and August), will we acquire a satisfactory knowledge of present distribution of the pewees that we need to guide us in detecting range extensions.

We agree with Coues, Trippe, Ridgway, and others that, despite their extraordinary resemblance in form and plumage, the two pewees have not been proved to be conspecific, and we treat them here as two distinct species. The determination of this question should be possible in the area of probable overlap in central-western Manitoba. We are aware of Rand's contention (Bull. Nat. Mus. Canada, 111, 1948:46) of "geographical intergradation," and fully agree that "certain Manitoba specimens are of doubtful allocation"; but much of the basis of Rand's discussion was worn July and August material, which we have seen, in plumage too faded to be useful in such a difficult group. We have not examined the alleged intergrades from North Dakota (Jewett *et al.*, Birds of Washington State, 1953:433).

The availability of the name *veliei* Coues has been another moot point in *Contopus* nomenclature. This name was rejected by its author, but he described its basis; thus it is not a *nomen nudum*, and we consider it to be available under the International Rules and Opinion 4. We do not concur, however, in Fort Whipple, Arizona, as the type locality. Coues characterically ranged far afield in his paper on the birds of Fort Whipple and Arizona, as has already been noted at one point by Swarth (Pac. Coast Avif., 10, 1914:28). From Coues' account, one cannot be sure that he had *any* Arizona specimen that he would have considered to be *veliei*. The only definite locality mentioned is "the mountains of Colorado Territory," and this specimen which is the first, as well as the only definite specimen mentioned, taken by Dr. Velie, must, in our opinion, be considered the type.

After careful study, Phillips is forced to concur in the placing of *placens* van Rossem in the synonymy of *veliei*. The description of *placens* was evidently due to faulty measuring (or faulty transcription of measurements and to the predominence of females, which are smaller and paler than males, in van Rossem's Madera Canyon series.

The race *saturatus* Bishop has had a checkered career. Nearly everyone agrees that Yukon birds are dark, yet few ornithologists recognize *saturatus*. This attitude stems from Ridgway, who remarked (Bull. U. S. Nat. Mus., 50, pt. 4, 1907:522, footnote) "I am, unfortunately, unable to verify any geographic correlation in the matter, these darker birds occurring almost everywhere outside the limits of the supposed subspecies." This sort of statement is all too rife in our literature, by authors who presumably consider pewees to be permanent residents in the Yukon! The one Yukon bird examined (University of Alaska) is somewhat darker than breeding birds *of the same sex* from Arizona; we therefore tentatively follow van Rossem (Occ. Papers Louisiana State Univ. Mus. Zool., 21, 1945:155) in recognizing *saturatus*.

The Mexican races hardly call for comment, except to remark that, in spite of statements to the contrary, we know of no evidence that any wood pewee winters anywhere in Central America.

With the rejection of *Tyrannula richardsonii* Swainson as inapplicable to any wood pewee (the name probably belonging in the synonymy of *Sayornis phoebe*), the species reverts to the next oldest available name, *sordidulus* Sclater. The races of the Western Wood Pewee, from north to south, should thus stand as:

Contopus sordidulus saturatus Bishop
Contopus sordidulus veliei Coues
Contopus sordidulus peninsulae Brewster
Contopus sordidulus sordidulus Sclater

We wish to thank W. Earl Godfrey, Thomas R. Howell and Brina Kessel for lending pertinent specimens, and H. B. Cott and J. D. Macdonald for their efforts to locate Swainson's type specimen. —ALLAN R. PHILLIPS, *Museum of Northern Arizona, Flagstaff, Arizona,* and KENNETH C. PARKES, *Carnegie Museum, Pittsburgh, Pennsylvania, November 9, 1954.*

Mid-winter Nesting of the House Finch at Los Angeles, California.— On December 23, 1954, a burst of rapid chirping by a House Finch (*Carpodacus mexicanus*) was heard coming from a light fixture on the south side of the Physics-Biology Building of the University of California, Los Angeles. Such light fixtures are about 12 feet above the steps leading into the building and are often used for nesting by House Finches; the fixtures have a small, peaked iron "roof" that shelters a space near the top, and this provides a well-protected nest site. There was a nest visible in the above-mentioned fixture, and the tail of the vocalizing bird could be seen projecting over the edge. On December 24 the nest was inspected several times and there was a bird on it each time. At 4:30 p.m. a bird flew off the nest to an adjacent tree where several other House Finches were gathered. The bird had no red in its plumage and was presumably a female although it could have been an immature male. It went into a begging display like a juvenile, with wings drooping and fluttering, but at the same time sang an adult-type song. One of the other birds then went through the motions of feeding the begging-singing one; whether or not any food actually passed between them could not be told. On December 29 a bird was flushed from the site and three warm eggs were felt within the nest. Later that day the incubating bird was heard chirping vociferously. On December 30 a bird was still incubating, and a male sang frequently from bushes near the nest site.

During the week of December 17 to 23 the weather had been clear and mild, with daily maximum and minimum temperatures ranging from 71 to 82°F. and 53 to 63°F., respectively. From December 24 to 31 the weather was still clear but colder, with daily maximum and minimum ranges of 58 to 64°F. and 42 to 50°F. January 1, 1955, was overcast all day and 1.20 inches of rain fell at the university campus; the temperature varied only between 53 and 48°F. January 2 was clear again, but the nest was deserted and the eggs were cold; possibly the inclement weather of the prvious day was at least partly responsible for the desertion.

Smith (Condor, 32, 1930:121) recorded a House Finch nest with four eggs on November 24, 1929, at Walnut Creek, Contra Costa County, California. The nest was empty 11 days later and it is doubtful if any young were raised. Winter nestings of this species are perhaps more common than the published records indicate, and data on hatching and raising of young, if any, at this season would be of interest.—THOMAS R. HOWELL and ROBERT D. BURNS, *University of California, Los Angeles, California, May 10, 1955.*

NOTES AND NEWS

COOPER SOCIETY MEETINGS

At the Annual Meeting of the Cooper Ornithological Society at Asilomar, Pacific Grove, California, on April 21 and 22, 1955, the following papers were presented: More about *Chendytes*, Extinct Diving Goose, by Hildegarde Howard; Song Recognition by the Bewick Wren, by William R. Fish; The Molts of the Anna Hummingbird, *Calypte anna*, by Francis S. L. Williamson; Notes on Birds of the Revilla Gigedo Islands, Mexico, by Thomas R. Howell and Bayard H. Brattstrom; W. W. Ellis: Naturalist-Artist with Captain Cook's Last Expedition; Paintings of North American Birds, by Theed Pearse; A Hybrid Woodpecker and Its Significance in Speciation in the Genus *Dendrocopos*, by Alden H. Miller; Nesting Birds of Alaska, California, Utah, and Colorado, by Sidney B. Peyton; A Nesting of the Spotted Towhee, by John Davis; Molt in Steller Jays of the Queen Charlotte Islands, British Columbia, by Frank A. Pitelka; Recorded Songs and Calls of Western Birds, by William R. Fish; A Strange Jay from the Isthmus of Tehuantepec, by Frank A. Pitelka, Robert K. Selander, and Miguel Alvarez del Toro; Some 1955 Observations on Robin Behavior, by Junea W. Kelly; Age Characters in Tropical Cactus Wrens, by Robert K. Selander; Population Density of Salt Marsh Song Sparrows, by Richard F. Johnston; Visible Migration of Loons and Other Birds at Point Lobos, by Laidlaw Williams and Elmer E. Highley. On the evening of April 22, Laurel Reynolds presented "Western Discovery," a motion picture.

SOUTHERN DIVISION

MARCH.—The monthly meeting of the Southern Division of the Cooper Ornithological Society was held on March 29, 1955, at the Los Angeles County Museum. The following names were proposed for membership: Mrs. Mary C. J. Gonie, Box 633, Chico, Calif., by S. B. Peyton; John H. Arnett, Jr., 6200 Arbleigh St., Philadelphia 38, Pa., Marguerite Caram, 42 Rue Montoyer, Brussels, Belgium, Earl Hazeltine Frothingham, 4702 Village Road, Long Beach 8, Calif., A. Peter Margosian, 11428 Santa Monica Blvd., Los Angeles 25, Calif., Dan R. McFadden, 1311 Montana St., Los Angeles 26, Calif., Miss Elizabeth C. Patterson, 15862 La Forge St., Whittier, Calif., Mrs. Bessie H. Ramey, 4305 Elenda St., Culver City, Calif., Dr. George Milton Stirrett, Canadian Wildlife Service, Old Arts Bldg., Queens University, Kingston, Ontario, Canada, Francisco H. Walz, Reconquista 453, Buenos Aires, Argentina, all by C. V. Duff; Otis D. Hyde, 32745 Gravelley Lake Dr., Tacoma 99, Wash., Joseph Beatty, 434 Kayne Ave., Chambersburg, Pa., Mr. T. C. O'Callagham, Maromaku R.D., Bay of Islands, Northland, New Zealand, and Dr. H. Lukas Hoffman, Tour du Valat, par le Sambuc, B. d. Rh., France, all by Jack C. von Bloeker, Jr.

Mr. Gerhard Bakker, Jr., Department of Biology, Los Angeles City College, and Mrs. Bakker presented a program entitled "Naturalists' Trek from Cape to Cairo," illustrated with colored slides and motion pictures.—THOMAS R. HOWELL, *Acting Secretary*.

APRIL—The regular monthly meeting of the Southern Division of the Cooper Ornithological Society was held on April 26, 1955, at the Los Angeles County Museum. The following names were proposed for membership: Laurence Charles Binford, Museum of Zoology, University of Michigan, Ann Arbor, Mich., by C. V. Duff; Elton L. Morel, 2637 E. Glenoaks, Glendale 6, Calif., by Mrs. John Q. Burch; and R. Dudley Ross, 16510 Las Casas Pl., Pacific Palisades, Calif., by Arnold Small. The name of Alfred Brazier Howell proposed for Honorary Membership by Loye H. Miller and Thomas R. Howell was read for the first time.

The following field observations were reported by Arnold Small: Black Scoter, January 29 at Huntington Beach and on February 5 at Malibu; Elf Owl at Cottonwood Springs, April 16; over 1000 Starlings at Sacramento Wildlife Refuge on Christmas Count.

"Studies of Wright Flycatchers in the San Bernardino Mountains," was the subject of the speaker, Dr. John Goodman of the University of Redlands.—DOROTHY E. GRONER, *Secretary*.

COOPER ORNITHOLOGICAL SOCIETY, INC.
STATEMENT OF CASH RECEIPTS AND DISBURSEMENTS
FOR THE YEAR ENDING DECEMBER 31, 1954

CASH IN BANK, December 31, 1953			$12,661.19
ADD: CASH RECEIPTS			
General Publication Fund			
Membership dues, regular and sustaining	$5,107.06		
Subscriptions for The Condor	822.65		
Condor Sales	743.14		
Phonograph record sales (8 records sold)	57.61		
Dividends and interest received on endowment funds invested (Note A)	2,576.73		
Contributions received for the publication of The Condor	537.64		
Other Cash receipts	17.44	$9,862.27	
Avifauna Fund			
Avifauna sales (net) (Note B)	$2,940.50		
Sales tax collected on Avifauna sales $12.64 less $11.25 disbursed to State with 1953 sales tax return	1.38		
Contributions	50.00	2,991.88	
Endowment Fund			
Life memberships and installment payments received on life memberships	$ 655.00		
Contributions	226.07	881.07	13,735.22
			$26,396.41
DEDUCT: CASH DISBURSEMENTS			
General Publication Fund			
Publication costs of The Condor			
Printing	$6,981.05		
Engraving	1,012.61		
Purchases of back issues	254.60	2,248.26	
Cost of phonograph records		5.42	
Administrative expenses			
Northern Division	67.70		
Southern Division	94.84		
Annual Meeting	214.95		
Accounting	174.00		
Business manager	221.74		
Treasurer and secretary	278.19		
Editor	19.40	1,070.82	
Avifauna Fund			
Avifauna No. 31, publication		5,432.24	
Endowment Fund			
Purchases of securities		2,347.19	17,103.93
CASH IN BANK, DECEMBER 31, 1954			$ 9,292.48

CASH IN BANK ALLOCATED TO FUNDS AS FOLLOWS:	December 31, 1953	December 31, 1954
General Publication Fund	$ 8,669.92	$8,205.19
Grayson Fund	213.66	213.66
Avifauna Fund	3,313.99	873.63
Endowment Fund	463.62	—0—
	$12,661.19	$9,292.48

NOTE A: At December 31, 1954, the business manager had in his custody endowment funds invested in corporate stocks which cost $28,704.29 and had a market value of $73,552.00 and $100.00 U. S. Treasury bond with a market value of $102.15. This endowment fund includes the contributions received in the names of Florence M. Bailey, Louis B. Bishop, Albert E. Colburn, Joseph Grinnell, Harry R. Painton, and Isabel A. Thomson.

NOTE B: At December 31, 1954, the Society had a stock of Avifaunas for which the total of the quoted list prices was $31,662.55.

C. V. DUFF, *Business Manager*

For Sale, Exchange, and Want Column—Each member of the Cooper Society is entitled to one short advertising notice in any issue of the Condor free. Notices of over 3 lines will be charged for at the rate of 25 cents per line. Send advertising copy to Jack C. von Bloeker, Jr., 161 West 121st St., Los Angeles 61, California.

FOR SALE—The Species of Middle American Birds, by E. Eisenmann, 128 pp., just published. Lists all species recorded from Mexico to Panama, inclusive, giving technical and English names, outlines of range, and a distributional bibliography of over 200 items; $2.00—LINNAEAN SOCIETY OF NEW YORK, *c/o American Museum of Natural History, Central Park West at 79th St., New York 24, N.Y.*

FOR SALE—Complete files of Bulletin of the Nuttall Ornithological Club, vols. 1–8, and The AUK, vols. 1–71 (Bull. Nuttall Club and vols. 1–18 of The AUK nicely bound, remainder unbound but in fine condition). Inquiries invited from interested buyers; proceeds to be deposited in the Endowment Fund of the Cooper Ornithological Society.—C. V. DUFF, *Business Manager, C. O. S., 1922 Tamarind Ave., Hollywood 28, Calif.*

WANTED—Scientific study skins of western and North American birds in general are needed for teaching purposes on two new campuses; also some mounted specimens are desired. Send your list of available material, or write for our want list.—ROLAND C. ROSS, *Los Angeles State College, 855 N. Vermont Ave., Los Angeles 29, Calif.*

INFORMATION ON BINOCULARS—For a simplified way to check the alignment of a binocular send for reprint of our booklet, "Know Your Binoculars," reprinting our earlier Audubon Magazine articles on how to choose the model most suited to your purpose and how to use it to best advantage, fully illustrated, 10c; both reprints free to members of Cooper Ornithological Society—write for your copies now. If your binocular is not functioning perfectly, send it to us for a free collimator check and repair estimate. If you need a new one, send for our list of complete lines of Bausch & Lomb, German, and Japanese binoculars and 'scopes. All instruments guaranteed adjusted to U. S. Government specifications, and sent on 30 days' trial. We answer questions personally; if you have a binocular problem, let us help you solve it.—THE REICHERTS, *Mirakel Repair Co., Mount Vernon 15, N. Y.*

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